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TELECOMMUNICATIONS

INTERNATIONAL

LASERS, SENSORS, OPTICS

Belgium: Organic Photon Carrier for Optical Computers Discovered

BR0612155693 Antwerp DE FINANCIEEL-EKONOMISCHE TIJD in Dutch 27 Nov 93 p 34

[Article signed VDB: "Report published in SCIENCE: Flemish Researchers Force Supercomputer Breakthrough"]

[Text] Seven researchers, most of whom are from Flanders, may have achieved a breakthrough in the application of non-linear optics. They have found organic molecules which are able to cling onto light frequencies and which can convert red light into blue light. The molecules, derived from the retina, could become carriers for non-linear photon transfer, opening up major new perspectives for information processing.

Photons, the basic carriers of light, are infinitely faster than the electrons that are now massively used in the world of information technology. The change from electrons to photons could usher in the new fifth generation of supercomputers. It could also give a whole new impetus to the artificial intelligence and robotics sector.

Andre Persoons, professor of the biological chemistry laboratory at the Catholic University of Leuven, announced the breakthrough in a speech. Yesterday's scientific journal SCIENCE published the paper written by Persoons and his research team on new organic photon-carrier materials. Persoons' coauthors on the paper were Koen Clays, E. Hendrickx, M. Triest, T. Verbiest, C. Dehu, and J.L. Bredas.

The research at Leuven University is carried out in association with Philips. Many large companies are currently doing research into nonlinear optics, with the realization that this could be the major breakthrough into the next generation of computers. It would represent not only a massive increase in data transfer speed, but also the elimination of heat generation. In addition to Philips, other companies such as ICI [Imperial Chemical Industries], Eastman Kodak, AKZO [General Potassium and Salt Company], Ciba- Geigy, Hoechst, IBM, Enichem, and Hitachi have all increased their research budgets for nonlinear optics.

Mr. Persoons claims that the discovery that certain proteins from the retina (bacteriorhodopsin, abbreviation bR) have this very special reaction to light, may represent a breakthrough in the application of nonlinear optics. The current mineral semiconductors that are used as electron carriers are very complex and expensive to manufacture, since the crystal structure of the mineral has to be physically altered.

The use of an organic material as carrier, in this case for photons, would also substantially reduce the cost to manufacture such elements. The chemistry is such that it is simple to manufacture large amounts of this organic material, such as the retina-based protein bR, for example, by producing analogues of the molecule.

Germany: Holographic Grating Developed for Environmental Analysis

94WS0059A Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 13 Oct 93 p 8

[Article by "JB": "Holographic Grating for Environmental Analysis and Laser Work. Optoelectronic Devices Can Become Smaller and Less Expensive/Resolution of 0.3 Nanometer"]

[Text] Frankfurt—Holographic gratings are optical microstructures that can be used in numerous ways in optical measuring systems and in laser equipment. The Berlin Institute for Optics GmbH [Limited Liability Company] (Rudower Chaussee 5, 12484 Berlin) has developed new kinds of holographic gratings that can be used in spectrometers for environmental analysis and for optimization of the application of high-power lasers.

As Dr. Christel Budzinski reports, optical microstructures like holographic gratings can be fabricated by processes that come from microelectronics. They include photolithography and dry etching. Holographic gratings can help to reduce the size of optoelectronic devices. The cost of these devices can also be lowered by the use of gratings.

Spectrometers in the field of environmental analysis are an application possibility. Incident light is split up spectrally and analyzed in spectrometers. These instruments have to be especially lightweight and compact if they are used in satellites for remote sensing, for determination of the state of terrestrial vegetation, for example.

A grating from Berlin specially developed for this purpose can help here. The spectrometer required operates in the spectral region of 650 to 800 nanometers. An image of a strip of the earth's surface (swath) is formed by means of a lens in the entrance slit and is then directed to the grating, where the spectrum is split into individual colors. The spectrum is then picked up by a photodetector array (CCD) and can be analyzed.

Atmospheric gases and changes in them as well as the state of vegetation can be detected in this way by estimating the red shift of chlorophyll margins. The holographic grating is the chief component. It defines the precision of the measurements. The spectral resolution, that is, the precision with which individual wavelengths can be differentiated, is especially decisive.

The resolution comes to 0.3 nanometer for the grating developed for the remote-sensing spectrometer. This also enables the spatial resolution of measured values in a modified spectrometer. Thus, the values for a swath can be associated with individual elements of the earth's surface, and this enhances the strength of the evidence of environmental analysis.

Laser technology is an additional application possibility for holographic gratings. CO_2 lasers above all have recently taken on importance in medicine and in the working of materials. This type of laser is very efficient and can be handled with precision.

This precision is closely associated with the diameter of the laser spot. The smaller the diameter of the beam, the higher the energy density and the more finely detailed the work

that can be done. Now holographic gratings can help to reduce the laser spot's size. However, conventional gratings fabricated by photolithography do not have especially high stress tolerance.

The gratings are ruined even at lower laser outputs. That is why the scientists in Berlin have fabricated holographic gratings by means of a molding process and with copper as the substrate. These gratings have substantially higher stress tolerance and thus can contribute to higher precision when working with high-power lasers.

German Developments in Microsensors Viewed

94WS0074B Duesseldorf WIRTSCHAFTSWOCHE in German No 44, 29 Oct 93 pp 122-125

[Article by Andreas Gerlach]

[Text] Sensors: Sense and Comprehension

Intelligent Systems Revolutionize Automotive, Environmental, and Medical Engineering

Hans-Hermann Braess has a bold vision. The research director at the BMW (Bayerische Motoren Werke) hopes "to duplicate man's unbelievable sensory abilities with technical sensors."

The further notion that components needed for such sensors "should not cost more than a few marks," seems to make him definitely a dreamer. Yet his vision is already close to becoming a reality.

With the aid of microelectronics, sensor technology has been thrust into an entirely new dimension. Today tiny sensors can already touch, taste, see, and hear. They measure position, pressure, angular speed, and humidity, or aid in analysis of chemical concentrations. These midgets are, moreover, much cheaper than conventional measuring sensors. While a conventional sensor recording the electrical conductivity of liquids costs about 400 DM, its microelectronic descendant can already be purchased for down to 10 DM.

This rapid price reduction has been made possible by known silicon processing techniques. Just as in the production of microelectronic chips, several hundreds of sensors can be simultaneously mounted on one wafer: a disk of the size of a beer cap.

Most progress microsensor engineering has made in the automobile industry. Already in the middle nineteen seventies Mercedes-Benz and BMW began making the automobile more intelligent by use of sensors. Neither antilock braking system nor electronic transmission control and also air bags would be conceivable without microsensors. For their de luxe limousines, moreover, Mercedes-Benz and BMW have also advanced the development of sympathetic shock absorbing systems so far that they are ready for the production line. Aided by a small acceleration sensor, the computer in the vehicle recognizes the road condition as well as the operating mode and then, within milliseconds, adjusts the drive characteristic accordingly.

This is only the beginning. Automobile developers envision in the future a rainfall sensor controlling the speed of windshield wipers. When a child suddenly appears on the road, electronic microoptics will respond faster than the driver. Soon a miniradar could take over navigation through a fog. "Till now intelligence was vested in the driver only," explains Hans-Hermann Braess, "but today one tries to impart intelligence to the automobile and to thus relieve the driver of his burden."

High Tech

Whether in vehicle design, process control, or environmental and medical engineering, the demand for bargain measuring sensors is increasing in leaps and bounds. While the total market volume of sensors worldwide already amounted to 30.6 billion DM in 1990, projections by the VDI/VDE Technology Center for Information Engineering Ltd in Teltow near Berlin (VDI: Verein Deutscher Ingenieure = Society of German Engineers, VDE: Verein Deutscher Elektrotechniker = Society of German Electrical Engineers) indicate an increase of the volume to 65.1 billion DM by the year 2000.

This growth is attributable most of all to microsensors. Their share ad valorem will climb from 10.2 billion DM to 43.4 billion DM. Whole armies of measuring "fleas" will conquer all areas of engineered life activities.

"So far the German sensor manufacturers hold a good position in this dynamic field" deems Walter Wiche at the Federal Ministry of Research and Technology (BMFT). A new assistance program has been unveiled by the BMFT offering financial support above all to small innovation-minded enterprises.

The pioneers in sensor technology can very well use this financial shot in the arm. It takes about four years for an idea to be converted into a marketable product. "For this one needs a long breath" knows Johannes Herrnsdorf, who five years ago together with Hans-Joachim Lilienhof has established the H.& L. Planar Technology Ltd in the Dortmund Technology Park. Only now are these two entrepreneurs able to build up their market with miniaturized temperature, magnetic field, and angle sensors. Business director Herrnsdorf of the H.& L. Planar is optimistic: "Next year we will finally find ourselves in the profit zone."

Yet innovations in microsensors are still advanced mostly by the large manufacturing firms, above all by Bosch, by both Dasa and AEG (General Electric Corporation) subsidiaries of Daimler-Benz, and by Siemens. The project developers are already working on second-generation sensors which will combine perception and comprehension, with sensors and signal processors integrated on one chip. Simultaneous fabrication of sensors and electronics is still in the experimental stage. "The semiconductor people become extremely anxious when etching is to be done on their contamination-free premises" complains Helmut Seidel, manager of microsensor engineering at Dasa in Munich.

For this reason Temic Telefunken Microelectronics Ltd, a joint enterprise of both Daimler-Benz subsidiaries AEG and Dasa established for consolidation of all microsystem activities of the parent corporation, is constructing its own manufacturing facility in its Swabian Nabern plant. Two years from now intelligent sensors, especially acceleration sensors, are to be produced in quantities up to millions of units.

The function they perform is based on the fundamental law pertaining to the moment of inertia of a body. On a silicon chip is etched out an almost entirely separate tiny square wafer which only three thin and narrow bridges connect to the remaining part of the structure. The position of this

wafer changes during acceleration and during braking. Those thin bridges then bend so that their electrical resistance changes. The electronics compute that resistance and, when necessary, release the air bag.

In this way such a microsensor will in future vehicle models replace the present three-to-five conventional accelerometers, with the additional advantage that it tests itself every time the engine is started.

The Mannesmann Kienzle Ltd in Villingen-Schwenningen is already installing such sensors in one mass-produced device: an accident-data recorder used for retaining the circumstances of an accident. The innocent drivers can thus be readily exonerated and the drivers at fault need not be afraid of the others testifying as key witnesses. So long as it is not legally mandated, they may refuse to surrender their cassettes with relevant data.

MICROELECTRONICS

European Affairs: JESSI partners Standardize 0,5-Micron CMOS Technology

BR0312093493 Paris ELECTRONIQUE INTERNATIONAL HEBDO in French 11 Nov 93 pp 1, 15

[Article signed J.-P.D.M.: "Europe Chooses Compatible O.5-Micron Technology"]

[Text] In June this year, as part of the JESSI [Joint European Submicron Silicon Initiative] industrial project, Philips, Siemens, SGS-Thomson, Matra MHS, GEC Plessey, Mietec [Microelectronics Technologies], and ES2 [European Silicon Structures] agreed to offer their clients, as of late 1993, common design rules for the development of their 0.5-micron CMOS [complementary metal-oxide semiconductors] integrated circuits [IC]. (Footnote 1) (The objective of the JESSI program is to make European semiconductor technology credible enough to win a respectable market share on the international scene, and above all to facilitate innovation in all electronics-based systems designed in Europe.)

Practical applications are now possible. Users can start designing 0.5-micron IC's thanks to the libraries made available by a number of suppliers, with so-called "relaxed" rules, so that an IC designed by one of them can be easily distributed later by another one, possibly as a second source. It is worth reminding that until recently, in Europe, the most advanced custom-made IC's were based on 0.7-micron technology. Small production runs of 0.5-micron custom IC's will be possible from April 1994, with large ones becoming possible in April 1995.

This "alliance at the top" is one of the consequences of the current good cooperation climate among the JESSI industrial partners, thanks to the action of JESSI President Heinz W. Hagmeister (the former president of Philips' IC division) and JESSI Vice President Guy Dumas (Matra MHS' former president).

This alliance confirms that what "pays" in any government-initiated endeavor is a long-term policy with clearly identified objectives. Now that JESSI has reached its mature stage, results will soon follow, the most significant ones being expected in computer-assisted design and 0.35-micron technology: There is today a high likelihood that the goal of a transfer to industry of a 0.35- micron CMOS technology that is mostly free of non-European components will be achieved. The European semiconductor industry could thus be able to offer ASIC's [application-specific integrated circuits] based on a 0.35-micron technology before the end of 1996, that is, before the JESSI program terminates.

IC's as of April 1994

The fact that there is design rule compatibility for 0.5-micron IC's among suppliers does not mean that the technologies of the participating companies are identical, apart from those of SGS-Thomson, Philips, and Mietec (Philips has been developing its technology at SGS-Thomson's Crolles [France] plant and Mietec is manufacturing IC's in Belgium under license from SGS-Thomson). For instance, SGS-Thomson's 0.5-micron, 3.3-volt technology is characterized by double-gate transistors which make it as fast as the 0.7-micron, 5-volt technology. And the company's stacked via technology with tungsten-filled holes makes for increasing integration density.

Starting dates for the distribution of the IC's will be slightly different depending on the company: The 0.5-micron technology is being tested by SGS-Thomson-Philips, Siemens, and Matra MHS, while qualification—and therefore the release of the final version of the 0.5-micron library cells—is scheduled for early 1994. As for ES2, GEC Plessey, and Mietec, they will be ready a few months later.

ES2, for example, will finalize its compatible design rules during the first quarter of 1994, and will market its 0.5-micron library in time for customers to start designing in the second quarter of 1994. At the same time, ES2 will conduct the qualification phase of its 0.5-micron technology—directly derived from the JESSI program—until late 1994 or early 1995, when the first operational 0.5-micron IC's will start coming out of the Rousset plant.

Germany: Fraunhofer Develops Process for Chip Applications

MI0712155993 Bonn WISSENSCHAFT WIRTSCHAFT POLITIK in German 3 Nov 93 p 4

[Text] A Fraunhofer team headed by Dr. Andreas Weber and working at the Fraunhofer Institute of Coating and Surface Technology's Hamburg laboratory is the first in the world to succeed in precipitating pure, golden-colored titanium nitride coatings from an organic titanium compound at low temperatures.

Titanium nitride is the hard material most widely used to coat tools such as drills and milling cutters to enhance their mechanical resistance. It will also perform a significant role in future memory chip generations, where it will form the barrier preventing the semiconductor material, silicon, from diffusing into the metallic strip conductors.

The Fraunhofer researchers had a number of tricks up their sleeves: They used tetrakis(dimethylamido)titanium as a volatile metal compound, which they fed into an ECR (electron cyclotron resonance) plasma together with nitrogen or ammonia. An ECR plasma is a particular form of excited gas state in which a magnetic field and an alternating electrical field are used to project and accelerate electrons onto spiral paths, a highly efficient method of activating gas molecules by inducing collision with electrons.

Golden Coatings at Boiling Temperature

The researchers in Hamburg manipulate the gases in this plasma in such a way that pure crystalline titanium nitride layers with ideal material properties can be precipitated at a temperature as low as 100 degrees Celsius; this cannot be accomplished below 500 degrees Celsius in conventional processes. The test parameters are set in such a way that the breakdown of the organic metal compound can be piloted to keep the layers free of the carbon impurities that would otherwise usually contaminate them.

The project was financed by the Federal Ministry of Research and Technology and managed by the VDI-TZ [Association of German Engineers Technology Center] in Duesseldorf. The low precipitation temperature makes the process attractive primarily for microelectronics applications and for coating temperature-sensitive substrates such as plastic. About 50 research teams worldwide have been working for around 10 years on precipitating this valuable substance from volatile organic metal compounds.

French Company Installs Fuji Fine-Pitch Surface Mounting Machine

BR0912134393 Paris ELECTRONIQUE INTERNATIONAL HEBDO in French 2 Dec 93 p 15

[Article signed J.M.: "SRPI Ready for 0.3-mm-Pitch Surface-Mounted Component Devices"]

[Text] The French subcontractor SRPI is the first company in Europe to acquire a Fuji FIPIII surface mounting machine which can produce surface mounted components [SMC's] at a 0.3-mm pitch.

To keep pace with the growing integration of electronic components (larger packages with increasingly numerous connections at an increasingly fine pitch), SRPI, a subcontracting company based at Redon [northeast France], has recently invested "several millions of French francs [Fr]" in a surface mounting line for fine-pitch SMC's. The main element in this line is the Fuji FIPIII machine, which is capable of assembling everything from chips using the 1005-format (1 x 0.5 mm) to QFP's [quad flat packs] at 0.3-mm pitches with 0.025-mm precision and TAB [tape automated bonded] and SMC connectors. SRPI is the first company in Europe to acquire this machine, and the second in the world (after an American GSM [Global System for Mobile Communications] terminal manufacturer).

With this investment, the French subcontractor is betting on the future. Few companies outsourcing work are currently looking for subcontractors capable of assembling SMC's at 0.3-mm pitch (SRPI has some requests for component assembly at 0.4 mm and 0.5 mm), but the natural trend toward increased miniaturization and complexity of electronic products means that this ability is a strategic advantage.

SRPI should generate revenues of over Fr120 million this year (including its non-electronics activities) and is predicting growth in the region of 15 percent in 1994.

Between November 1992 and February 1994, the company will have invested some Fr10 million in its industrial production facilities.

International Firm Launches 0.7-Micron Technology for ASIC Production

BR0501150294 Paris ELECTRONIQUE INTERNATIONAL HEBDO in French 16 Dec 93 p 28

[Unattributed article: "0.7-Micron Complementary Metal Oxide Semiconductor Technology Optimized for Complex, High-Speed, and Low-Consumption Application-Specific Integrated Circuits"]

[Text] ES2 [European Silicon Structures] has just started producing a new optimized 0.7-micron CMOS [complementary metal-oxide semiconductor] technology for the manufacture of highly complex, high-speed, and low-consumption ASIC's [application-specific integrated ciruits]. This technology, which carries the reference ECLP07, is designed for circuits operating at 3.3 volt and presenting an integration density of 1,300 gates per square millimeter for logical functions (7,000 gates per square millimeter for memory functions). The technology also features a frequency of 150 MHz (identical to that of current 0.7-micron 5-V CMOS technology) for a consumption cut by a factor of 2.3 (1.5 microwatt per gate and per megaHertz).

New Microelectronics Firm in Dresden Founded

93ws0535b Duesseldorf HANDELSBLATT in German 14 Jun 93 p 15

[Text] Dresden—After lengthy negotiations the contracts for founding the Zentrum Mikroelektronik Dresden GmbH (ZMD) in Dresden were signed on 27 May 1993. As early as last October it was agreed that ZMD was to be removed from the parent company Mikroelektronic and Technologiegesellschaft (MTG) and taken over by the holding companies of the Commerzbank AG, Frankfurt/M., and the Dresdner Bank AG, Frankfurt/M., each taking half. The privatization is under committee supervision.

For Saxony's economic minister, Kajo Schommer (CDU), this sale marks an important technological policy goal for the Land: "Saxony will remain a standard in microelectronics in the production of user-specific circuits." In Saxony about 100,000 jobs depend directly or indirectly on microelectronics, Schommer said. East Germany's other two significant microelectronics firms in Erfurt and Frankfurt/O. have already been privatized by their trusteeship.

The support for this project is considerable: According to statements of the trustees, Siemens AG will provide knowhow and personnel in areas of technology, production techniques, marketing and sales for three years. There is a fairly good chance that ZMD could develop as a supplier for Siemens, not least through licenses which Siemens will make available.

The Free State will provide the liquidator for MTG with DM40 million for research and development for ZMD and an additional DM10 million until 1996 for the purchase of property and buildings. The trusteeship will support the undertaking for the next three years with opening financing in the amount of DM135 million. Schommer thought that it would be clear in 1995 that faith in ZMD had been justified.

There is still quite a bit to be done: Last year ZMD achieved sales of DM7 million. According to the designated president of ZMD management, Kurt Garbrecht, this year sales should amount to DM15 million, but this is not yet guaranteed. For 1994 he said that the objective would be sales of

DM50 million and in 1995 DM100 million. Costs should be covered by production by 1996. Garbrecht, who most recently was leader of the internal microelectronics division at Siemens, estimated financial needs up until 1995 (loss coverage and investments) at approximately DM130 million. MTG liquidator Wilhelm A. Schaaf confirmed that with the support of the trusteeship, the Land of Saxony and the EC there is complete financing for ZMD. He said that the ZMD plan was firm.

German Microelectronics Industry Sees Future in ASIC's

94WS0074A Duesseldorf WIRTSCHAFTSWOCHE in German No 44, 29 Oct 93 pp 118-122

[Article by Wolfgang Kempkens and Andreas Beuthner]

[Text]

Microelectronics: Custom-Made Suit for Chips

By offering semiconductor specialty products, Europe will now improve its position on the world market. The European microelectronics industry is not getting off its crawling start. While Japanese and Taiwanese manufacturers are further enhancing the top position the Far East holds in memory chips and American electronics giants such as the Intel Corporation are reaping billions in profits with their microprocessors, the barometer readings for this industry on the old continent have again fallen to the the bottom. "Europe has only half-heartedly responded to the drastic reconstruction process taking place in the semiconductor industry worldwide" soberly states Hans Weinerth, former manager of Philips and today chief of Sican GmbH (GmbH = Ltd) in Hannover which produces special custom-made chips.

"Whoever wants to catch up here must not nibble at but take a whack at it" believes Jens Uwe Fuhrmann of the German Machine and Plant Construction Society (VDMA). Yet the European chip industry has suffered for years from a frightening lack of motivation. Only Siemens, jointly with the IBM Deutschland GmbH (German IBM Ltd), still bearably holds on to the mass market for memory chips. The twosome recently delivered their first 64 Mbit chips to selected customers.

The European Research Initiative JESSI (Joint European Submicron Silicon), although established for the purpose of developing this particular chip as closely as possible alongside the Japanese, has since changed its orientation. "Memory technology was virtually stricken from the European agenda" admits Heinz Hagmeister, just recently appointed JESSI chairman.

A general breakdown of the domestic microelectronics industry, however, Hagmeister refuses to concede: "We are still holding some trump cards." It is slowly dawning on the JESSI board members in charge that the billions of research money squandered in laboratories on unmarketable projects actually help countries like Japan, Korea, and the U.S.A. to remain leaders in electronics.

The situation is, indeed, becoming more and more critical. The European chip users are becoming more and more dependent on non-European chip producers. "Japan has assumed the leading role all the way from making semiconductor materials through fabrication of chips to manufacture of electronic products" complains Michael Pero, director of Microelectronics in the Technology-Strategy and Innovation Projects (TES) division of the Daimler-Benz AG (AG = Corporation).

There is absolutely no shortage of new places where to start. Professional market watchers are raising Europe's expectations in this field by their discovery of a demand for microelectronic components called ASIC's (Amorphous-Silicon Integrated Circuits) designed to meet user's special requirements.

These components can be used in washing machines, mobile telephones, machine tools, automobiles, and in practically all electronic circuits, each component as a rule in only a very specific kind of electronic device. They often replace an entire series of mass-produced chips and thus remain each suitable for only a particular device targeted for miniaturization. They furthermore perform their specific task most often faster and more reliably than an electronic circuit built with mass-produced chips.

"The success of European products hinges neither on the degree of integration nor on the storage density of chips" acknowledges Max Syrbe, since a few weeks ago president of the Fraunhofer Society. Extremely fine structures striven for in mass-produced chips are not needed in an ASIC. Inasmuch as only the functions needed for performance of its specific task are built into it, an ASIC is by far not as crowded as a 64 Mbit chip.

The chances are good that, by pursuing the ASIC line, Europe's semiconductor industry will again catch up with the leading manufactures of semiconductor devices and especially so since the Fraunhofer Institute of Silicon Technology has focused its attention on precisely this particular concept. A comfortable new Institute building is currently being constructed in Itzehoe with Europe's largest contamination-free space for research and development. Two thousand square meters of floor area will be made available to the Institute's researchers and collaborating experts from industry. Relocation from the present site in Berlin is scheduled to take place in the second half of 1995. The Institute will provide the technical prerequisites for a quantum jump in ASIC development. The equipment on hand for this purpose is designed to produce chip structures of sizes smaller than half a micrometer. This will lead to an actual manufacture of ASIC's and thus to further progress in the miniaturization of devices.

According to Weinerth, chief of Sican, there are still openings for entry into competition with other semiconductor manufacturers for share of the world market. "Our ambition must not be to gain a few percentage points on the world market with standard products", admonishes the former JESSI man, "but rather to offer specialty products."

Despite the favorable position for a good start, marketable products are still scarce. Exceptions include the world's highest-speed silicon chip developed at the Ruhr University in Bochum. The know-how for this device has been acquired by the Daimler-Benz Corporation. Then the Institute of Discrete Mathematics (IDM) at the Bonn University has developed layouts for new chips which the IBM Deutschland (German IBM) GmbH now uses. But on the whole, says IDM chief Bernhard Korte, the European semiconductor industry is fast asleep.

The greatest weakness lies in transmitting the know-how from the laboratory to the industry. A man who wants to correct this is Prof. Dieter Seitzer in Nuremberg. His efforts should benefit most of all middle-class consumers. This incumbent Chair of Engineering Electronics professor at the Erlangen-Nuremberg University, who is also director of the Fraunhofer Institute of Integrated Circuits, knows what the trouble is with the group of people he will confront: "Researchers and potential users are still too timid to communicate with one another properly."

The agile professor visualizes covering West Europe with a hundred competence centers which will assist every prospective user in the design of ASIC's. The laboratory facilities of the Fraunhofer Institute in Erlangen are today almost ready to handle telephone orders. Meanwhile, however, the JESSI project is still in its infancy. Besides the Erlangen Institute, only the Braunschweig Institute of Applied Microelectronic has a so-called chip shop available for custom design of ASIC's.

Seitzer is not the only one promoting such services. The Thuringia Microelectronics Application Center (MAZeT) Ltd, in which the city of Erfurt and also the Weinerth-Gican enterprise and the Jena Optics Ltd participate, offers assistance not only in ASIC development but also in almost all areas of microelectronics. Because of this capability, the Center occupies a unique position in Germany, having competence in advance microelectronics also at its disposal.

German Research, Policy, Support for Microsystems Technology

Government Support Policy

94WS0086A Duesseldorf WIRTSCHAFTSWOCHE in German 29 Oct 93 pp 110-113

[Article by Ulf J. Froitzheim: "Revolution of the Dwarves"]

[Text] Seen with the naked eye, the crumbs look like fly specks. But Wolfgang Ehrfeld is holding real treasures in his hands: Ultrasmall microturbines, which do not reveal their true shape until placed under a high-resolution microscope. Such microsystems, assures the managing director of the Institute for Microtechnology Mainz (IMM), are once again radically changing the industrial world: "Even today we still have no concept of most applications."

What until recently still smacked of science fiction—tiny robots which independently repair machines, carry off calcification in blood vessels or self-navigating vehicles equipped with microsensors—are slowly but surely becoming reality in the laboratories from Mainz to Madison, Wisconsin, from Tuebingen to Tokyo. Microcomponents are already being used in fiberoptics networks and medical equipment, as well as in everyday articles such as ink jet printers and air bags.

German companies and researchers are involved at the forefront of this promising future technology and are even leading in some subareas. Professor Anton Heuberger at the Fraunhofer Institute in Berlin and Daimler researcher Walter Kroy in Munich are two of the most famous pioneers in silicon microtechnology. The newer and more flexible Liga [lithography, electroforming, casting] process, with which tiny parts can also be made from metal, ceramics or synthetics, was developed by IMM head Wolfgang Ehrfeld in the 1980s at the Karlsruhe Nuclear Research Center (KfK). And Dortmund Microparts GmbH—a joint venture of the Steag, Krupp/Hoesch, Huels, Rheinmetall and VEW groups—is considered worldwide to be the only company which has mastered large-series manufacture of micromechanical systems. The team around managing director Reiner Wechsung can produce 120,000 microscopic little gearwheels in one operation. "In basic research and first products we are probably ahead of the United States and Japan." Rainer Guenzler of the Institute for Micro-and Information Technology (Imit) of the Hahn-Schickard Society in Villingen confirms the European lead but with the reservation: "In patents the Japanese are unequivocally ahead." Guenzler should know: His institute, supported by the land of Baden-Wuerttemberg, helps medium-sized mechanical engineering manufacturers introduce microtechnology and therefore painstakingly keeps track of pertinent activities at home and abroad.

But Imit cannot supply a reliable analysis of the future world market in microtechnology. Even professional market watchers are stumbling about in the fog. The Market Intelligence Research Corp. (Mirc) in Mountain View in Silicon Valley predicted last fall that worldwide turnover in microsystems and microstructures would surpass the three-billion-dollar mark as early as 1995; last spring Mirc corrected the sum to 2.9 billion—and the year to 1998.

Battelle Memorial Institute also reports contradictory data: While its Frankfurt branch, now closed, at the end of last year predicted a market volume of 20 billion German marks [DM] for the year 2000, Battelle Europe now anticipates only sales of eight billion dollars in this market by the turn of the century.

On the other hand, should the daring assumptions be correct on which the Federal Ministry [for Research and Technology, BMFT] supports the draft of its second subsidy program for microsystem technology (period: 1994-1999), the anticipated world market could be much greater: Microcomponents are to represent a full four percent of the sales price for cars in the construction year of 2000. Even in the worst economy that would be more than DM 20 billion. In Europe alone microsystems worth DM 3.6 billion would then be built into telecommunications facilities. In this context the BMFT does not even mention the application field of medical and pharmacological technology, regarded as particularly promising.

The prophets only agree on one point: that an additional technological race between Europe, Japan and the United States is coming—its outcome still open.

All three sides are ready to invest. In the United States the research authority ARPA (Advanced Research Projects Agency) has taken up the subject. ARPA manager Kaigham J. Gabriel, himself a former microengineer, is allowed to spend 24 million dollars in seed capital over three years.

In Japan, micromachine development is focused on the Micromachine Center (MCC) in Tokyo, in which such illustrious companies as Fanuc, Hitachi, Kawasaki, Matsushita, Mitsubishi, Seiko or Toshiba are participating. In 1991 the Ministry for Industry and Trade, MITI granted 25 billion yen (DM 387 million) to a 10-year program aimed at

the concrete task of joint construction of a millimeter-large, automatic blood vessel scrubber.

Such a joint leitmotif is missing in the German program for microsystems technology, whose first part runs out at the end of the year. Over the past three years the bureaucrats in Bonn dissipated their energies on no fewer than 31 (Japan: five) joint projects with 224 partial projects, whose DM 148 million budget was split equally between industrial companies and research establishments. Even the whole dozen of the Fraunhofer institutes involved conduct largely uncoordinated research. For example, only four belong to the pan-European microtechnology elite group Nexus, which is run by Heuberger's Fraunhofer Institute for Silicon Technology (Isit) in Berlin.

While the BMFT is now preparing to kick off the second round of subsidies with the prospective sum of DM 400 million, Liga inventor Wolfgang Ehrfeld prefers to fight his own fight. As founder of the IMM subsidized by the Rhineland-Palatinate, the ex-KfK employee wants to show how efficient German research can be.

"I wish for more competition in research and development," Ehrfeld taunts the solicitous ministerial technocrats, "because that is the only way to mobilize the reserves which lead to innovation."

The ambitious professor, helped by the economics minister of Rhineland-Palatinate, Rainer Bruederle, has thus within two years built a fully equipped think tank from the ground up—mainly filled with second-hand, like-new equipment. Since then the IMM has grown to 100 employees, already finances 25 percent of itself through industrial contracts and, in addition to MicroParts, is regarded as the most important address in Liga technology. The Mainz team is not satisfied with applications in the branches of telecommunications, medicine, pharmacology and automobiles, but in addition devotes itself to improving production technology and the associated equipment development.

Together with the Lothar Spaeth company Jenoptik in Jena, the IMM developed a precision scanner for deep lithographic production of tiny molds needed for mass production of Liga microparts. Since there is no comparable equipment on the world market, inquiries and orders have already come in from Europe, the United States and the Far East.

Old and established entrepreneurs often shy away from that much high-tech, even if the innovations would soon have immediate impact on their business. In mechanical engineering, the BMFT estimates, 60 percent of the companies will be forced to use microsystems components. But only five percent of the companies would develop such products themselves.

So the employees at Imit in Villingen, which as a supplier of R&D is to pave the way to the future for the traditional Black Forest precision mechanics companies, will also have to do a great deal of persuading. Sighs Rainer Guenzler: "It is not easy to convince the head of a small company that he should invest in new things precisely during the recession."

Flexible Alternatives

Various methods are available in order to produce microscopically small components. The conventional methods, for instance etching of fine structures, are derived from silicon processing. The advantage: benefiting from years of experience in semiconductor manufacture.

But that does not compensate for the serious disadvantage, namely fixation on the material silicon. The Liga technique—Liga stands for the three principal process steps of lithography, galvanizing, casting—developed by Wolfgang Ehrfeld at the Karlsruhe Nuclear Research Center (KfK) in the 1980s is now revealing itself as a highly promising and flexible alternative. Ehrfeld: "We can produce components from gold, copper, synthetics or ceramics."

The principle is simple. Through a mask a radiation-sensitive synthetic is irradiated with X-rays. A solvent etches out the affected surfaces, and the hollows are filled in a galvanic process with nickel. After removing the residual synthetic, the metal structure serves as a mold for the production of the actual parts.

In this manner Ehrfeld produces new kinds of fiberglass plugs from the synthetic PMMA, a mass product which costs only pfennigs although it has a dimensional tolerance of less than one-thousands of a millimeter.

These are not the only such applications to make the Liga process famous beyond the science. While the method has so far been kept under lock and key up by the KfK, Ehrfeld with his institute is deliberately taking a different tack: "If we want to have any chance at all versus the established silicon methods, we must open up the Liga process to all who are interested."

That is precisely what the busy research entrepreneur is doing. He organized an international network of Liga users, which he is busily continuing to expand. By now, more than 30 groups are likely to be working with this method worldwide. To be sure, this leads to the German share of the Liga cake becoming smaller. That is the intention for Ehrfeld: "That is the only way the method can become established and plant builders and other suppliers can become interested in it."

The market resulting form it, according to Ehrfeld, "more than compensates for the lost monopoly."

Microsystems for Medical Treatment

94WS0086B Duesseldorf WIRTSCHAFTSWOCHE in German 29 Oct 93 pp 116-118

[Article by Bettina Weberling: "Grenades in the Blood Vessels"]

[Excerpts] They are so small that they can wander through arteries, veins and the smallest pipes. Like worms—supplied with a long umbilical cord—the tiny machines crawl through the human body or through motors, cutting or grating here and widening there.

Micromachines such as these, which take over the maintenance work in bodies or in machinery or independently carry out environmental monitoring, are still utopian. But tiny individual parts for these micromachines are already being developed. [passages omitted]

Until now this field has been dominated by rigid endoscopes, through which even simple, mechanically remote-controlled tools can fit such as scissors, knives or hooks with which to catch stones, for example. Such systems are offered by the medium-sized companies Karl Storz GmbH and Co.

in Tuttlingen and Richard Wolf GmbH in Knittlingen, among others, each of which has a world market share of about 30 percent.

But the next generation, with which small surgical tools can find even better application, is already announcing itself: semiflexible endoscopes, such as from Fujinon (Europe) GmbH in Duesseldorf.

Unlike rigid tubes, the semiflexible endoscopes can be aimed more precisely at the target in the body. Jochen Cramer, sales director for Europe at Fujinon, estimates the existing world market for such systems at DM 70 million, of which market leader Olympus Optical Co. Ltd. in Tokyo has assured itself of 85 percent.

Such flexible endoscopes are also attractive when looking for damage in engines and drives. While conventional diagnosis of heavy truck engines takes almost 10 hours because the engine has to be disassembled into individual parts, with the endoscope the analysis is done in a little over 30 minutes. As in the medical field, the goal for the microtechnology developers is the independent mini-machine, which undertakes externally controlled repair work either by itself or with a joystick.

Before using it in the human body, however, the researchers must still solve the energy question. While most micromachines that pass through veins, those which so far have been presented as prototypes, need power as an energy source, Wolfgang Menz, head of the Institute for Microstructure Technology at the Karlsruhe Nuclear Research Center (KfK) is concentrating on the fluidics, that is to say gases or fluids under pressure. "If we use carbon dioxide or a physiological table salt solution, that is harmless to the human," according to Menz.

Over the next few years he wants to develop an intelligent endoscope subsidized by the Federal Ministry for Research and Technology: A tiny robot which moves like a submarine in the body's passages. It is equipped with a video camera which transmits live pictures on the surgical video screen. The operator who controls the submarine can manipulate various tools when needed: A router removes deposits that could lead to heart attacks on the walls of the blood vessels, a rotating knife removes diseased tissue and a needle guided by the robot hand sews up the fresh wound.

Among the first users of this technology could be Kaimund Erbel, head of cardiology at the University Clinic in Essen, who has specialized in prevention of heart attacks. In theory Erbel's micromachine is already perfect: a miniaturized, rotating ultrasound head which scans the interior walls of the heart and coronary vessels. The pictures from a person's inside allow for much more precise conclusions regarding the danger of heart attacks. "Right now we can only detect deposits once the vessels are already up to 40 percent closed," says Erbel. "With the ultrasound head we can see them even at five percent."

Furthermore, the type of deposit can be seen. This determines the choice of tool: a diamond-equipped router, which mechanically eliminates the obstruction, or a laser which vaporizes them. The tissue waste left behind by the miniature drill is considered critical by many experts, but Erbel regards it as harmless. The tiny pieces of calcium and fat, according to the heart specialist, cannot endanger the patient.

But it will be years before Erbel has to deliver proof of this. Microsystems cannot be used in the human body until after extensive tests. This gives Menz, the researcher in Karlsruhe, time to, as he hopes, develop equipment that works even more targeted and less brutally than a router.

"After all, it has the effect of a hand grenade tossed into the arteries," he says with vivid criticism of the vein drill. For that reason Menz is concentrating on intelligent diagnostic capsules which can be swallowed and on their way through the body search for cancer, for example. Such a submarine could then, according to the scientist's ideas, be immediately loaded with the appropriate medicines for combating the degenerated cells.

New Materials for Microsystems

94WS0086C Duesseldorf WIRTSCHAFTSWOCHE in German 29 Oct 93 pp 125-126

[Article by Markus Schnurpfeil: "Wall on Command"]

[Text] Foturan is hard to the touch. The silicate glass withstands temperatures up to 550 degrees Celsius as well as attacks by aggressive chemicals. "Also, Foturan can be optimally combined with other materials into hybrid structures," muses Burkhard Speit, head of product development for the optical business sector at Schott Glassworks in Mainz, in whose laboratories the special glass was developed.

Originally, Foturan was to be used by Siemens AG for the construction of flat screens. But the Munich electronics group halted the development of flat tubes—and Schott had to look for other users for his wonderglass. They were soon found: Sensors for high-temperature application, for example, are being made based on Foturan. The Schott strategists now hope also to establish their silicate glass as a material for microsystem technology.

Foturan can—partly irradiated with ultraviolet light and then etched—be made into tiny mold parts. It is also suitable for the manufacture of perforated boards. The people in Mainz have already managed up to 800 holes per square centimeter. "We see application possibilities for example in mountings for optical waveguide fibers."

In the development of new materials for microscopically small components, the experience from the world of macrosystems can only be conditionally applied. "Often the mechanical properties of materials for components in the microfield are totally different from construction with normal sizes," according to Professor Erwin Sommer, head of the Fraunhofer Institute for Material Mechanics (IWM) in Freiburg.

Right now, materials experts in industry and at research institutes are primarily occupied with optimization of already available materials, such as certain synthetics or ceramics, for their use in the microsystem field. By means of filmy-thin coatings, improvements in the process technology or—much simpler—the correct combination of various materials, "completely satisfactory solutions can be achieved" (Sommer) for the microsystems planned at this time.

The development of totally new, to some extent tailor-made materials, is still not pursued with any force, at least for the moment. The reason for this is simple. Schott researcher

Speit says: "We want to push ahead with the use of microtechnology systems, we do not want to wait five years for the development of a totally new material."

At this time experts see the broadest application field in medicine—and at the same time the adjustment of the working material is the most difficult here. "We can only make use of a palette of 20 materials, whose biocompatibility has been attested to by the Federal Health Ministry," explains Bernd Amecke, a microsystem expert at the pharmacological group of Boehringer Ingelheim. When modifying them in order to optimize them for certain microsystems he must apply for a new permit in order to use them in human beings. And that takes time.

Obstacles of this kind can only briefly hold up the materials designers, however. That is because materials technology is likely to play a dominant role as early as with the second or third microtechnology generation, the concepts of which are already being drafted in the industrial research departments.

Here the researchers will penetrate down to the molecular structure of the materials. At the Max Planck Institute for Polymer Research in Mainz people are combining molecules which independently merge into new materials with the desired properties. The head of the institute, professor Gerhard Wegener says: "It is as if bricks were to combine to form a wall on command."

At the Institute for New Materials (INM) in Saarbruecken one has also specialized in molecular puzzles. Here, for example, glasses and ceramics for use in microsystems are being optimized, by deliberately contaminating them with tiny foreign particles. The particles are so small that a quadrillion of them can fit on a pinhead.

The result of this molecular material composition is so-called smart materials, intelligent materials, which under varying pressure conditions can change their stability. "The trend in microsystem technology in the next few years is unequivocally heading toward increasingly intelligent materials," confirms INM employee Herbert Krug and confidently promises: "Technically we have already mastered it."

Germany-U.S.A.-Toshiba Collaboration in "Quarter-Micron Project"

94WS0122B Berlin INGENIEUR DIGEST: WIRTSCHAFT & UNTERNEHMEN in German, Nov 93 p 32

[Article by Ulrike Scholz]

[Text]

German Strategies

The "Quarter-Micron" project, the Siemens-IBM-Toshiba alliance for joint technological development of 0.25 µm structures, is yielding the first experimental chips.

John Abernathey invited us to a photo opportunity. The "Quarter-Micron" project leaders from the participating Siemens, IBM, and Toshiba enterprises are in a good mood. They have accomplished a lot indeed in this one year since the contract had been signed. "We are entirely on schedule" says Hans Schuster-Woldan of Siemens. Since January he is heading one of the most diverse teams of workers from all three firms in East Fishkill, about 100 km north of New York. "The first experimental chips produced by the quarter-micron technology are already available" he announces proudly.

In order to prevent further runaway of costs for development of ever more finely structured chips, these three large DRAM producers from the competing camps of Europe, U.S.A., and Japan decided last year to such an unprecedented alliance. They are sponsors of the joint project designed to develop a technology of producing fine chip structures. The is to develop processes which will yield 0.25 µm wide structures. As the first product they want to come out, by the middle nineties, with a 256 Mbit DRAM (Dynamic Random-Access Memory): a semiconductor memory with optional access to all 256 million memory cells.

If this project succeeds, it will be owing to Siemens alone that Europe has regained ground in microelectronics. This is by far the only enterprise which devises such clever strategies. All other microelectronic firms still just swim behind the technological leader.

Instead of all joining forces, each enterprise in Germany—industry and institutes alike—tries to keep its head above water with with its individual solution.

What looked so promising in 1990, when the fathers of the JESSI EUREKA program found a new home and new task for the Fraunhofer Institute of Silicon Technology (ISiT) in Itzehoe, has in the meantime turned into dust. The Institute was supposed to explore new processes for structurization of microchips by x-ray lithography. Soon, however, did the Research Minister cut off the funds for this because the "large industry has abandoned x-ray lithography." The ISiT chief Prof. Dr. Anton Heuberger notes today: "Since the European firms had largely stopped manufacturing memory chips, there was no prime user of this technology to be found in Europe. We therefore had discontinue our efforts."

This assessment is, of course,not quite correct in view of the activities at Siemens. Rather, photolithography was also applicable to much smaller structures than had been assumed at that time. The Japanese tried it already then on KrF excimer lasers. And for this reason, evidently, the large industry let x-ray lithography go.

A new concept made it nevertheless possible to begin construction of the ISiT in Itzehoe, after both Federal and State governments released the funds. Meanwhile very large-scale integration was been abandoned and somewhat smaller integration is being targeted: Only system integration, hybrid technology, and ASIC's (Amorphous-Silicon Integrate Circuits) for the medium-size industry are now considered.

Esprit Project to Develop Chip to Receive, Transmit Nerve Impulses

94WS0095B Duesseldorf HANDELSBLATT in German 11 Nov 93 p 22

[Article by Rolf Schwarze and Heike Wiegand, professional journalists, Eschwege, under the rubric "Research and Technology": "Medicine/Ambitious Esprit Project: Nerves Made of Silicon. Artificial Limbs Will Be Controlled by Nerve Impulses"; first paragraph is an introduction]

[Text] Wednesday, 10 Nov 93 (HANDELSBLATT)—Scientists at Centro Nacional de Microelectronica (CNM) in Barcelona are working on the development of a new chip

that, implanted in the human body, can receive nerve impulses and forward them to various parts of the body. Nerves destroyed (in an accident) could be replaced by them in the future. Artificial arms and legs could be controlled by nerve impulses for the first time by means of this chip.

The idea for this originated already around two and a half years ago. But the man-machine communication had to be feasible, they realized at the CNM laboratory. An ambitious research project that the European Community is generously subsidizing within the Esprit program has sprung from the idea in the meantime. Together with five other laboratories in Germany, Italy and Switzerland, CNM's scientists are working on the development of a new microchip that could open up new pathways for medicine.

However, Centro Nacional de Microelectronica is taking the main share of the "Intelligent Neuronal Interface" project. "We are still at the very beginning," Rosa Villa, who as a physician is watching over the CNM project, says, curbing overhasty expectations. The goal is the development of a chip that, implanted between the split nerve ends, is to act as a communication bridge between the nervous system and outside information processing system.

A prototype has already been designed in the meantime: a silicon chip one square millimeter small that is like a miniature sieve. The microperforation was achieved by neutron bombardment, explains Jordi Aguiló, head of CNM's design department. "The only effective method by which the chip's circuits are not damaged."

The development of a biocompatible material for the chip case has been likewise difficult. But this problem has also been solved by now. The chip's biocompatibility has by now been tested with success in experiments on animals, Rosa Villa attests. The chip was implanted in rats. The next phase of the research can begin. The nerve chip is to act as the receiver of rat-nerve signals that are interpreted by a computer. Additional findings for further development of the chip are hoped from this.

Similarly to TV relay stations that amplify the signals for reception at more distant points, the chip already permits signal transmission from the brain to nerve intersection points. Rosa Villa explains the future capabilities that follow from this: "The chip could replace destroyed nerves and be used in order to control artificial limbs."

If the latter sounds improbable, it is not in the opinion of the CNM researchers. After all, it is theoretically possible to decode signals from the brain at severed nerves, Jordi Aguiló explains. "Thus it must also be possible to forward these brain signals through the chip to an artificial arm or leg."

Rosa Villa: Unlike conventional pacemakers that can only transmit commands, the chip will be interactive. "A miniature electronic brain that is compatible with the human nervous system can receive neural signals, process them and transmit them to various parts of the body or to artificial limbs."

There is still a way to go before this point. "This is a long-range research project whose end cannot be foreseen yet today." Rosa Villa also knows that it will be a few years before this chip can be implanted in the first patient. "It will not be feasible before the year 2000."

NUCLEAR R&D

Italy: Synchroton Facility Used By Pharmaceutical Companies

MI1712144593 Turin MEDIA DUEMILA in Italian Nov 93 p 78

[Text] Three multinational pharmaceutical companies, Ciba- Geigy, Sandoz, and Hoechst, have already scheduled experiments at Elettra. Elettra is a super microscope that uses synchrotron light and began operating in Trieste on 4 October. According to the three companies, in the future 80 percent of the research into the structure of new pharmaceuticals will be performed using this extremely powerful insturment.

Elettra, the most powerful super microscope in Europe, took 6 years to build and to date has cost 300 billion lire. Inside Elettra electron beams are brought an energy of 1.5 Giga electron volts by a linear particle accelerator and are then injected into an accumulator ring containing curved magnet and other devices that cause them to loose energy under the form of synchrotorn light.

This intense radiation is then directed into channels leading to experimental laboratories where the researchers work. The light produced acts like an extremely powerful microscope that is capable of observing matter, both organic and inorganic, in great detail. "It is unique in the world because of the particular 'brilliance' of its light beam," said the physicist and Elettra Scientific Committee President Giorgio Maritondo, "this light is capable of investigating the chemical bonds of the molecules contained in any given substance." Elettra can be used in the field of biology to examine the distribution of toxic elements in cerebral cell systems.

The "light" will not be used for pharmaceutical research alone. Many other sectors will benefit from Elettra: Its 50 "light lines" will enable unique experiments to be performed, both basic and applied research, in the field of computer science for the production of integrated circuits; in the mechanical field for the manufacture of microcomponents, and in the chemical sector for the study of new materials.

France: French Nuclear Experiment Heavily Criticized

MI2712095893 Munich SUEDDEUTSCHE ZEITUNG in German 3 Dec 93 p 8

[Article by Markus Klingenstein: "MCA Experiment Went Off According to Plan—Fuel Rods in Test Reactor Heated to Melting Point: Comparison With Harrisburg Accident"]

[Text] The MCA [maximum credible accident] experiment that the French CEN [Center for the Study of Nuclear Power] research center in Cadarache has postponed time after time for several months went off according to plan on Thursday, as far as the experts have been able to judge to date. This experiment, which has been strongly criticized by environmentalists, involved turning off the cooling water supply to a small portion of the Phebus research reactor, thus for the first time simulating a "maximum credible accident" (MCA) in a nuclear power station. The fuel in the 80- cemtimeter long and 12-cm thick tube was heated to the point where it began to melt. The scientists compared their

experiment with the accident in which the Three Mile Island nuclear power station in Harrisburg narrowly escaped a catastrophe in 1979.

This time, however, the faulty portion was 5,000 times smaller than in a conventional power station, and the surrounding reactor continued operating quite normally. The researchers at the French Institute of Nuclear Safety and Protection (ISPN), who had overall responsibility for the planning of this international project, are convinced that they would have been able to stop the experiment at any time in an emergency. However, German engineer Peter von der Hardt, the European Union's representative in Cadarache, maintains that safety precautions were so strict that no radioactive material could have escaped in any circumstances.

The Phebus experiment began on schedule shortly after 1000 on Thursday morning with the preheating of the reactor. The whole procedure was transmitted live to the nearby press center, where scientists gave a commentary. A screen showed how the surroundings of a core immersed in a water tank began to glow blue—the sign of radioactive radiation being generated in the reactor. While the major portion remained at the normal operating temperature of several hundred degrees Celsius, the lack of cooling in the actual inner test core ensured that its temperature continued to rise slowly. After one hour and a half, at 800 degrees Celsius, the fuel rods began to crack inside. Another two hours later, the housing was so hot that it reacted chemically with its surroundings, with the result that the temperature of the test object rose sharply from 1,400 to 2,200 degrees in the space of a few minutes. A measuring tube inside it burst, and the gas collection tank radioactivity meter registered the first fission products, thus ringing in the hot phase. In the subsequent hour, the temperature approached the fuel melting point. At 1500, sufficient molten fuel had accumulated, and the experiment was brought to an end. Von der Hardt confirmed, however, that it was not yet known for sure whether the results of the MCA experiment were applicable to existing nuclear power stations.

France, Belgium Create Neutron Detector

94WS0105A Paris AFP SCIENCES in French 4 Nov 93 pp 11-12

[Article: "French-Belgian Demon at Catholic University of Louvain"]

[Text] Louvain-la-Neuve—It is French-Belgian, it was made to travel, and it has been mischievously christened Demon. Despite its name, this equipment, which should shed new light on the mechanisms of the reactions produced by the collision of heavy ions, was officially inaugurated at the Nuclear Physics Institute (IPN) of the Catholic University of Louvain-la-Neuve on 28 October.

The ceremony was attended by several dozen physicists and engineers, among them Claude Detraz, director of the Institute of Nuclear Physics and Particle Physics (IN2P3) of France's CNRS [National Scientific Research Center], and individuals responsible for designing and developing the detector: Mr. Youssef, Mr. Masri, and Francis Hanappe, who are researchers at Belgium's National Scientific Research Fund (FNRS); and Guy Bizard and Bernard Heusch of the CNRS.

Designed to be easily disassembled and moved, Demon (Modular Neutron Detector) was financed equally by the IN2P3/CNRS and the FNRS (20 million Belgian francs each) and built at four laboratories: the nuclear physics laboratories at the Free University of Brussels and the University of Louvain-la-Neuve, the Corpuscular Physics Laboratory (LPC) in Caen, and the Nuclear Research Center (CRN) in Strasbourg. The result is that following a preliminary series of measurements scheduled for December with Cyclone (the IPN's cyclotron), Demon will be transferred to GANIL (Large National Heavy Ion Accelerator) in Caen in 1994 and then to Vivitron in Strasbourg in 1995.

Demon's designers emphasize that it constitutes "technological progress" chiefly because of the amount of electronics and informatics it contains. In other words, it could not have been built a few years ago. Demon also benefited from work in the same field that was done by Charles Ring on the Eurogam detector (used by Vivitron).

What are the limits to the existence of nuclei—that is, what is the maximum number of nucleons possible in a nucleus, what are the respective proportions of neutrons and protons beyond which or below which a nucleus is no longer stable, and to what extent can one perturb a nucleus (by causing it to absorb energy) before it explodes (the phenomenon of multifragmentation)?

Demon should help provide answers to some of those questions, which still constitute an unsolved problem in nuclear physics.

Bernard Tamain of the LPC in Caen explains that in Louvain (where Cyclone delivers beams of 10 MeV per nucleon of energy) and in Strasbourg, the new apparatus, with its 96 detectors (including liquid scintillator plus photomultiplier) mounted on a spherical frame measuring four meters in diameter,[1] will be "a chronometer making it possible to measure the fast fission of nuclei, the lifetime of a very hot nucleus, and those 'reflex' times of nuclear matter that govern the fusion mechanisms." Its capabilities: times on the order of 100th of a billionth of a billionth of a second.

In Caen, where the energy supplied to GANIL can reach 100 MeV per nucleon, the new equipment will be able to track the hottest nuclei up to temperatures of 100 billion degrees.

But Demon will also be used as a microscope for studying the most "exotic" light nuclei (those presenting a large excess of neutrons compared to the corresponding ordinary nuclei) that it is possible to produce today, examples being lithium-11 and carbon-19. Lastly, the new installation will make it possible to measure neutron sizes down to one-billionth of a micrometer.

It will therefore be possible to begin neutron detection—a difficult task compared to the detection of charged particles—within a few weeks using the equipment in question, which is unique in Europe.

Hot Nuclei and Exotic Nuclei

When perturbed by another nucleus, a target nucleus distributes the energy imparted to it among its components, the nucleons. If the excitation energy reaches a certain threshold and threatens its existence, the nucleus—which is then called "hot"—"cools" itself by the emission of protons and

neutrons (the phenomenon of evaporation) or by fission into two or more fragments (known as multifragmentation).

Studying the emission of neutrons enables one to learn about the excitation energy achieved by the nuclei, their de-excitation processes, and their lifetime (the time it takes them to return to stability). The hotter the nucleus, the stronger and faster the emissions.

Heavy ion accelerators can also produce light nuclei which, unlike stable "ordinary" nuclei (in which the number of neutrons is close to that of protons), have too many neutrons. Examples are ^{11}Li (three protons, eight neutrons) and ^{19}C (six protons, 13 neutrons). In an "exotic" nucleus of that kind, neutrons will be randomly distributed in a "halo," making the nucleus very unstable. The nucleus will return to stability by emitting its least firmly bound neutrons.

Detecting two neutrons simultaneously and measuring their speed (their "time of flight") and their angle of emission provides information on the limits to the existence of nuclear matter.

Footnotes

1. Twenty-four of those detectors, perfected by the CRN in Strasbourg in cooperation with Philips-France (in Brive-la-Gaillarde), are equipped with a Charged Particle Rejection System (Syrep) that also includes a scintillator combined with a photomultiplier.

CERN Director Proposes Thorium-Based Reactor

94WS0153D Paris AFP SCIENCES in French
25 Nov 93 p 16

[Article: "Revolutionary Nuclear Reactor Proposed by CERN Director"]

[Text] Geneva—Nuclear generating plants powered by an inexhaustible energy source that is also virtually risk-free and poses no military proliferation threat: This is the revolutionary project unveiled on 24 November in Geneva to some 500 physicists from all over the world by Professor Carlo Rubbia, director of the European Particle Physics Laboratory (CERN).

Speaking in CERN's crowded amphitheater, the Nobel Prize-winning physicist explained that ecological concerns had motivated his conception of this project, which builds on earlier work and consists essentially of an "energy amplifier" driven by a heat-producing particle accelerator. In other words, the project consists of "extracting energy from heavy nuclei with the help of nuclear cascades induced by an accelerator." One might even go so far as to envision an "upsurge in global demand for nuclear energy to replace fossil fuels" such as hydrocarbons that engender so-called "greenhouse gases" and contribute to warming of the earth's atmosphere.

According to Mr. Rubbia, the particle amplifier, which would use thorium (abundantly available) rather than uranium as fuel, represents a safer solution because the reactor would be "subcritical" and there would be no danger of chain reaction.

Mr. Rubbia noted the general public's misgivings about traditional nuclear reactors in light of accidents such as Three Mile Island and Chernobyl and the need to bury highly radioactive waste products for very long periods of time. Use of thorium in this way would offer the advantages of "being simple, safe, cleaner, not posing any important technological hurdles, nonproliferating, and inexhaustible," Professor Rubbia said. Small plants would produce virtually no plutonium, and "no one could make a bomb with it." But Professor Rubbia concluded on a warning note: The project is still at the stage of "virtual reality, and experimental verification will be required," along with very complex calculations, before the idea is implemented.

According to CERN spokesman Neil Calder, Mr. Rubbia has computer-tested his theory and plans to begin experimental work on it next year at CERN. Most of the physicists reacted positively to the proposal, Mr. Calder said.

In his presentation, the Nobel Prize-winner said his work was based on research done in the 1950s by W. Lewis (Canada) and more recently by Professor C. Bowman's team at Los Alamos (New Mexico). At the end of December, Mr. Rubbia will step down as director of CERN, which he has headed for the last 5 years, and will be replaced by Christopher Llewellyn Smith. He will then devote himself entirely to his energy project.

SUPERCONDUCTIVITY

Danish Project to Build 100 Meter Superconducting Cable by 1995

94WS0026A Stockholm NY TEKNIK in Swedish
2 Sep 93 p 8

[Article by Staffan Dahllof: "Nordic Superconductor in Two Years"—first two paragraphs are NY TEKNIK introduction]

[Text] In two years seven centimeters of Danish superconducting wire will have grown to 100 meters of usable electric cable. A Nordic industrial project is aimed at resistance-free electricity transmission in 1995.

"It looks promising," said Ove Albertsson of ABB Corporate Research.

The 7-centimeter long superconducting fragment is found at the research center of the NKT (Nordic Cable and Wire) company in Copenhagen. The wire handles a current density of 70,000 amperes (A) per square centimeter, 70 times more than an ordinary copper cable.

According to the creators this is a world record. There are longer superconducting cables in Japan, it is true, but there the current density is only 10 times greater than it is in traditional electric cables.

Sometime in 1995 NKT promises to demonstrate 100 meters of superconducting cable that can transmit 50,000 A/cm^2 without loss.

"We will see various application possibilities emerge in time, but direct current transmission over short distances may be one of the first applications," said project leader Torsten Freltoft.

The joint development project is backed by not only NKT but also ABB, Norsk Hydro, Chalmers Institute of Technology and the technical institutes in Copenhagen, Tammerfors and Trondheim.

Ove Albertsson of ABB's research division said that nitrogen-cooled superconductors can be used in many electric power contexts.

"It will probably involve more than simply replacing copper cables. Superconductors will also give us entirely new properties. But we will not know what these may be until we have the cables."

"ABB's official position has been that Japanese and American companies are in the lead. But I have become increasingly convinced that NKT is in the top echelon. Their work looks promising," he said.

The development of ceramic superconductors accelerated in the mid-1980s. They came to be called high-temperature conductors where high means warmer than absolute zero and preferably over -196°C., the limit for using liquid nitrogen as a cooling medium. Although a number of different alloys have proved to be superconductive the industrial breakthrough has been a long time coming.

The alloy that the Nordic cable developers are working with consists of bismuth, lead, strontium, calcium and copper oxide. The production process is called the powder in tube method. Powder is packed into a silver tube with a diameter of 5-7 mm. The tube is stretched to a thread and rolled out to a 0.1-mm thick band that is then sintered in an oven.

"Now and then there are reports of new usable alloys in the literature. We test them too, but we expect to continue working with the method and the material we have now," Freltoft said.

The Nordic industrial project, based in Copenhagen, has a budget of around 40 million kronor, half of which is supplied by industry. The Nordic industrial fund contributes 15 percent. The rest is financed with various national grants.

TELECOMMUNICATIONS

Portugal's Telecommunications Infrastructure Described

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[Article by Sarah Griffiths, based on Datapro International Telecommunications report: "Portugal: The Commercial and Regulatory Environment"]

[Text] Although regarded as having one of the least developed telecommunications infrastructures within the European Community, Portugal has made great advances in the sphere of telecommunications over the last four or five years and has achieved a telephone main line density of 32 percent—a figure which, nevertheless, falls well below the Western European average.

Portugal's first telecommunications service was a private network which started in 1877, and later developed into the Anglo Portuguese Telephone Company (established in 1887) operating a local telephone service in Oporto and Lisbon. This company subsequently became the public company, Telefones de Lisboa e Porto (TLP), in 1968—still with the same regional coverage. The Portuguese PTT was responsible for serving the domestic telecommunications needs of the remaining regions of the country—this too became a public company in 1970. Intercontinental connections (including telex, satellite, and submarine cable links) are handled by Marconi Communicaoes Globais (until recently known as Companhia Portuguesa Radio Marconi, or CPRM, and currently in the process of changing its name), which has been in operation since 1922.

During 1992, Portugal suffered alongside most of the rest of Europe from the general recession with GDP growth estimated to be less than 1.8 percent for the year (compared with 2.5 percent for 1991). Portugal's population of just over 10.5 million enjoys one of the lowest levels of unemployment in Europe, standing at around 4.7 percent in early 1993. Inflation has also been falling gradually over the last few years—8.9 percent at the end of 1992 and still falling.

Politically, Portugal has had a somewhat chequered history until Mr. Anibal Cavaco Silva (together with his Social Democratic party, the PSD) achieved his first general election victory in 1987—followed by two subsequent re-election victories. The next general election is due in 1995. Since joining the European Community in 1986, although still one of the lesser developed member states, Portugal has made considerable progress propped up by a ready flow of EC development grants.

According to ITU [International Telecommunications Union] statistics for 1991, Portugal's record for investment in telecommunications proportional to GDP is well out in front of the rest of Europe (both East and West) at around 2.2 percent of GDP. The European average is roughly 1.8 percent of GDP. This illustrates Portugal's commitment to modernizing and developing its telecommunications infrastructure—as quickly as possible—in order to be able to cope with the increasingly competitive global telecoms market.

Regulation of Telecommunications

Major regulatory changes started to take place during the early 1980's. Although under Law No. 188/81, issued in 1981, the State still retained monopoly control over public post and telecommunications services, it did liberalize the terminal equipment market and acknowledged the need to make further reforms. The law also created the Instituto das Comunicaoes de Portugal (ICP) as an advisory body to the government, but the ICP did not become the official regulatory body until 1989.

Mr. Fernando Mendes, the president of the ICP (the Portuguese telecommunications regulatory body), in his paper presented at the ITU's Asia Telecom conference in Singapore in May 1993, outlined the developments that have taken place in recent years towards establishing an efficiently regulated telecommunications industry. As a initial start in 1986, the Commission for the Communications Institutional and Technological Development Study (CEDITC) was set up to reassess the communications industry and liberalization of services—a process which involved discussions with the public operators, trade unions, user groups, and industry representatives. The main recommendations included:

—The separation of postal and telecommunications services

—The creation of a financial holding company for the postal and telecommunications services within the CTT [Postal and Telegraph Services of Portugal], as well as for the public telecommunications operators, TLP and the

former CPRM, with the eventual aim of removing the cross-subsidization of postal services

—The gradual liberalization of basic services

—The strengthening of the ICP's role as regulator

—The move towards flexible tariffs for non basic services and cost-related tariffs for basic services.

The Commission's recommendations were incorporated into the government's program as of August 1987.

The development of Portuguese telecommunications legislation (i.e., the CEDITC report and the Basic Telecommunications Law) has been just one step ahead of the European Commission's directives. This has made implementation that much more straightforward and given support to the government's program for telecommunications. The Basic Telecommunications Law, which was approved by Parliament in September 1989, relates to telecommunication network infrastructures and differentiates between private and public.

—Private telecommunications networks are owned by and for the exclusive use of the organization—e.g., for the armed forces and railways, and private radio networks. The government is responsible for authorizing such networks.

—Public telecommunications falls into two categories: a) networks for public use (i.e., the fixed telephone and telex services, and a switched data transmission service), and b) complementary networks and services, as well as mobile networks (i.e., mobile cellular, paging, videotex, e-Mail, EDI [Electronic Document Interchange], and trunked radio network services), and value-added services (i.e., services which add value to the basic or complementary services, such as audiotex, public fax, voice mail services).

The Telecommunications Law established that, in the case of public telecommunications, networks for public use were to be operated on a monopoly basis, whilst complementary and value-added services were to be gradually liberalized.

Towards the end of 1990, Laws No. 329/90 and No. 346/90 were passed covering the regulation and conditions necessary for the liberalization of these services. Value-added services may be provided by any authorized operator, subject to certain conditions regarding security, tariff levels, and information content. Complementary services have been separated into mobile and fixed services: mobile service provision is subject to public tender and under government control, whilst fixed services may be offered once a license has been granted. Certain further conditions also prevail, such as the fact that both fixed and mobile service operators may not transfer their license to another operator within three years of setting up operations. Nor may a licensed operator take more than a 10 percent holding in any other operator providing a similar service.

During 1992, a number of laws have been passed affecting the telecommunications sector and these include:

—Law 88/92 (May 1992) established CN-Comunicaoes Nacionais, SGPS, SA as the holding company for all state holdings in the communications sector (i.e., Telecom Portugal, TLP, Marconi Comunicaoes Globais, and TDP—Teledifusora de Portugal), as well as postal operators.

—Law 98/92 (May 1992) changed the status of the PTT, CTT-Correios de Portugal (or CTT) making it a state-owned public limited company.

—Law 186/92 (August 1992) set up a Higher Committee for Telecommunications to advise the government regarding coordination of the different telecommunications systems in the country.

—Law 207/92 (October 1992) set up a new pricing scheme for services provided by the public telecommunications operators.

—Law 277/92 (December 1992) established the regulations under which Telecom Portugal SA was to exist after separation from the CTT.

With the introduction of competition, both private companies and the three existing public telecommunications operators in various collaborative ventures have applied for licenses to operate. Altogether, as of May 1993, licenses had been granted to two GSM [Global System for Mobile Communications] operators, four paging operators, and two fixed data network operators. Still under consideration were licenses for two trunked radio networks, as well as authorization for around 13 value-added services (e.g., videoconferencing, telex, videotex). As of September 1993, there had been little further development. However, as a result of a public tender, Radiomovil was awarded a license to operate a trunked radio network in mid-1993. A second operator's license should be awarded towards the end of 1993.

For some time, Portugal has been the only EC country not to have introduced some form of tariff rebalancing. The public operators have now begun to lower the price of long-distance calls and increase the price of local and regional calls, thereby bringing Portugal more into line with the rest of Europe. Marconi Comunicaoes Globais embarked on rebalancing its tariffs in 1992, with Telecom Portugal following suit in 1993.

Administration of the Portuguese telecommunications environment is the responsibility of the Instituto das Comunicaoes de Portugal (ICP—with full authority finally being granted in November 1989 (as a result of Law No. 283/89 being passed in the preceding August). The government nominates the three members of the ICP's Board of Directors, who serve for three years, with possible renomination at the end of this period.

The ICP advises the government on the determination of policy and legislation, as well as having a series of more specific regulato y duties, which include:

—Standardization and type approvals

—Radio electronic spectrum management, planning, and supervision

—Setting of tariffs

—Monitoring the operating conditions and quality of the basic telecommunications services (i.e., telephone, telex, and data transmission service)

—Allocation of licenses to operators of complementary and value-added networks and services

—International representation of Portugal in international telecommunications organizations, such as ITU, CEPT

[European Conference of Postal and Telecommunications Offices], OECD, and the EC.

With offices in Oporto, the Azores, and Madeira, the ICP employs 270 people—half of whom come from the CTT and are involved in management of the radio spectrum. The annual budget of around US$20 million is generated almost entirely from spectrum tariffs.

The PTT Today

There are three operators of public telecommunications services in Portugal:

—Telecom Portugal

—Telefones de Lisboa e Porto (TLP)

—Marconi Comunicaoes Globais (until recently, Companhia Portuguesa Radio Marconi, or CPRM).

Since the 1980's there has been a considerable rejuggling within the Portuguese telecommunications sector. Figures 1 and 2 illustrate the changes that have been achieved over the past decade.

Telecom Portugal

The Portuguese PTT, CTT-Correios de Portugal, ceased being a government department in 1970. In accordance with the Basic Telecommunications Law (passed in 1989), the CTT's telecommunications sector adopted the name Telecom Portugal SA in March 1990 and formed an autonomous company. By mid-1991, Telecom Portugal was responsible for its own budget and the determination of strategies. In December 1992, Telecom Portugal finally became a fully-fledged public limited company. Telecom Portugal's remit is to provide the fixed telephone and telex services for the whole of Portugal, with the exception of the cities of Oporto and Lisbon. In addition, the operator handles traffic to Europe and the Mediterranean region.

Figure 1. Portugal's Telecommunications Sector, as of 1980

The Ministry of Public Works, Transport and Communications oversees the Secretary of State for Communications who in turn oversees both CTT and TLP. The Ministry of Finances administers IPE, who in turn administers CPRM [Portuguese Radio Marconi Company].

(Source: "Regulation of Portuguese Communications", Paper presented by Mr. Fernando Mendes at the ITU's Asia Telecom '93 conference, held in May 1993.)

Financial results to the end of 1992, published by the CTT-Correios de Portugal, include the figures for both postal (Correios de Portugal) and telecommunication (Telecom Portugal) service providers. Income from operations totaled 232.2 billion escudos [Esc] for 1992 (compared with Esc205.0 billion in 1991). Income from telecommunications services totaled Esc144.6 billion (Esc123.7 billion in 1991).

Telecom Portugal currently employs around 11,000 staff, but there are plans to cut staff numbers by around 18 percent by the end of 1994.

Telefones de Lisboa e Porto (TLP)

Originally starting its operational activities in 1887 as the Anglo Portuguese Telephone Company (APT) under a franchise contract, Telefones de Lisboa e Porto (TLP) holds the monopoly over the fixed telephone service within the Oporto and Lisbon regions. Although TLP provides service coverage to barely 3 percent of the territory, this includes provision of services to the most densely populated areas and the major business centers. TLP is a 100 percent publicly owned company.

—TLP's net profit for 1992 totaled Esc1,279.9 million (down from Esc1,472.4 million in 1991), with cashflow reaching Esc28.6 billion (an increase of 7 percent over 1991). Income from operations jumped by 14 percent to Esc17.6 billion.

—The number of employees fell by 2.5 percent during 1992 to total 10,343. This brought the ratio of employees to main lines to just over seven employees to 1,000 main lines.

Over the past few years, TLP's investment in the infrastructure has been considerable. During 1992, investment in telecommunications made up around 84 percent (Esc42,235 million) of the total Esc50,275 million—33 percent of which went on switching and 41 percent on outside plant.

Like the other public operators, TLP is also concerned with strengthening its involvement in the domestic telecommunications market, and with the advent of competition it sees investment in these competing operators as a strategic move. One such investment is TLP's 50 percent holding in TELEPAC, which totaled Esc2 billion—77 percent of the operator's total financial investment of Esc2.6 billion for 1992.

Altogether, TLP holds stakes in 19 companies—including a number of joint-venture companies with one or both of the other operators—representing an overall investment of Esc6.3 billion. Figure 2 shows the structure of TLP.

Figure 2. Portugal's Telecommunications Sector, as of 1993

The Ministry of Public Works, Transport and Communications oversees the Secretary of State for Communications. Reporting directly to the Secretary of State for Communications are CN- Comunicacoes Nacionais (Financial Holding for Communications) and Instituto das Comunicacoes de Portugal. CN-Comunicacoes Nacionais oversees: Post, Telecom Portugal, TLP, CPRM and TDP. Post, Telecom Portugal, TLP and CPRM are Reserved Areas (Post, Fixed Telephone and Telex).

Instituto das Comunicacoes de Portugal oversees three Competition Areas: a) Public Competition (Complementary), comprising TMN [Telecomunicacoes Moveis Nacionais], TLM, TELEPAC, SEVATEL, CTT-Azores and CTT-Madeira; b) Private Competition (Complementary), comprising Telecel, Telechamada, Finacom, Contactel and Comnexo; and c) Private Competition (Value- Added Services), comprising Televoz, Audiomedia, Mor Audio Tel, On Street Marketing, STVA, Interinfo, Telebanco, INMTEL, Teleworld.

Instituto das Comunicacoes de Portugal is also overseeing (along with CN-Comunicacoes Nacionais) the reserved

areas of Post, Fixed Telephone and Telex. (Source: "Regulation of Portuguese Communications", Paper presented by Mr. Fernando Mendes at the ITU's Asia Telecom '93 conference, held in May, 1993.)

Marconi Comunicaoes Globais

Starting operations under a franchise contract in 1922, Marconi Comunicaoes Globais (until recently known as Companhia Portuguesa Radio Marconi, or CPRM, and currently in the process of changing its name) was originally set up to provide reliable communications with offshore islands (i.e., the Azores and Madeira) and Portuguese colonies and interests in Africa and the Far East. The state has a controlling share of 51 percent in Marconi Comunicaoes Globais.

Marconi Comunicaoes Globais is responsible for telex and intercontinental communications, provided via satellite and submarine cable networks which it has developed in partnership with other international telecommunications operators. During the 1990's, the company has become more diversified in its range of services and has started to offer mobile communications, value-added services, and business communications.

—During 1992, Marconi Comunicaoes Globais generated income of Esc42,561 million (Esc41,010 million in 1991) and net profits of Esc3,671 million (Esc7,565 million in 1991). Cashflow stood at Esc8,160 million—down from Esc11,327 million in 1991. Investments totaled Esc9,991 million, compared with Esc16,024 million in 1991.

—For the first quarter of 1993, Marconi Comunicaoes Globais showed an increase in net profit (Esc1 billion) of 5 percent on the 1992 first quarter results. Turnover for the period was Esc10.4 billion. Of this figure, the telephone service contributed Esc8.2 billion (up 8 percent on 1992)—notable given that the tariff rates were 21 percent lower during the 1993 first quarter than in 1992. Investment of Esc625 million was also carried out during the 1993 first quarter, with the majority channeled into the development of the global telecommunications network.

—For the first six months of 1993, the company reported profits of Esc2 billion (up 11 percent on 1992) and cashflow of Esc4.5 billion (up 12 percent on 1992).

During 1992, the demand for international telephony services increased by 14 percent, whilst mobile, data, and videoconferencing services showed increases of over 25 percent. This growth was due largely to the increase in the network capacity, as well as the introduction of new services for large business customers (e.g., VPN [Virtual Private Network] networks, ATM [Asynchronous Transfer Mode] switching, high-speed transmission, and frame relay services). A further result of the tariff cuts during 1992, was a significant growth (16.9 percent) in intercontinental traffic.

In addition to the joint-venture companies formed with the other public telecommunications operators, Marconi Comunicaoes Globais has major holdings in a number of telecoms-related companies:

—Contactel—(51 percent) Portugal's second paging operator

—Marconi SVA—(90 percent) provider of value-added services

—Telesotto-Sociedade de Videotex, SA (45 percent)

—Marconi-Sprint, Lda (51 percent)—Set up in mid-1991, this is US Sprint's first venture into the Portuguese market and offers international voice and data services

—SUBTEL-Sociedade Portuguesa de Cabos Submarinos Telefonicos, Lda (50 percent)

Marconi Comunicaoes Globais is a global communications company with operations in more than a dozen countries. With headquarters in Lisbon, Marconi Comunicaoes Globais has six international offices in Brussels (Belgium), Washington DC (U.S.A.), Sao Paulo (Brazil), Macau, Angola, and Maputo (Mozambique). Marconi Comunicaoes Globais' major international joint-venture companies include:

—Mobitel—(49.5 percent) a company formed with a number of local partners in Brazil, offering paging services. The license was awarded at the start of 1992 and the service was launched in September 1993.

—Guine Telecom—(51 percent) the operator of the national telephone network—also the operator of a land mobile service (launched in 1991) with national coverage in Guinea Bissao.

—CST (Companhia Santomense de Telecommunicacoes), SARL [Limited liability corporation]—(51 percent) national telephone network operator in Sao Tome and Principe.

—CTM (Companhia de Telecomunicacoes de Macau), SARL—(28 percent) national telephone network operator in Macau.

—TELEDATA de Mocambique, Lda—(50 percent) provider of services including videotex and electronic mail in Mozambique.

—Matrix—provider of paging services in the Philippines, Malaysia, and Thailand.

The Onset of Competition and Joint Ventures

The 1990's have demanded that the three public telecommunications operators become more prepared for competition from private operators for customers. In particular, the opening to competition of the markets for digital cellular telephony, paging, data communications, and value-added services has resulted in the three public telecommunications operators combining forces in a number of complementary service areas to form independent, autonomous operations units—such as TMN. Much of this reorganization is taking place through the holding company, CN—Comunicaoes Nacionais. Further reorganization is planned, in particular the TELEPAC consortium is expected to incorporate all data services including videotex, as well as value-added services (e.g., those currently offered by Servatel and Marconi-SVA).

—Telecomunicacoes Moveis Nacionais (TMN)—jointly owned by all three public service operators and licensed to operate Portugal's mobile cellular telephone service.

—TELEPAC-Services de Telecomunicacoes SA—jointly owned by TLP and Telecom Portugal and established during the course of 1992. It brings together the public data transmission and videotex services formerly provided by the two operators.

—Telemensagem—jointly owned by Telecom Portugal (49 percent) and TLP (51 percent) and is licensed to operate the existing public paging service.

—SEVATEL—a provider of electronic mail (MHS 400) and electronic data interchange services. Both TLP (49 percent) and Telecom Portugal (51 percent) are shareholders.

—TEXTRAM—a value-added services provider, specifically offering videotex databases for road transport operators. Both TLP (20 percent) and Telecom Portugal (20 percent) are shareholders.

The Telephone Network

While most of Portugal's European neighbors have been concentrating on building networks fit for the 1990's, Portugal still has a fair way to go before catching up. At 32 lines per 100 population, Portugal has one of the lowest telephone line penetration levels in Western Europe—although the level for urban areas is somewhat higher.

Telecom Portugal

In terms of network coverage, Telecom Portugal is the major operator of public telecommunications services in Portugal, with a network covering around 97 percent of the country and service two-thirds of the population.

Due to the increase in demand for telecommunications, Telecom Portugal's installation of telephones has increased from 20,000 telephones each year at the beginning of the 1980's to 263,000 telephones in 1992. This has also reduced the numbers waiting for telephone connections by 35 percent to 91,400 at the end of 1992 (141,700 at the end of 1991).

As a result, within Telecom Portugal's area of operation, the number of telephones has grown by 16 percent and telephone density has almost doubled in the last four years to reach 25 telephones per 100 population in 1992—compared with 13 telephones per 100 population in 1988.

As well as expanding the network, Telecom Portugal has been intent on modernization and, in particular, digitalization of the network. Table 1 gives an overview of Telecom Portugal's network infrastructure.

Telecom Portugal; Network Infrastructure, 1990-92

	1990	1991	1992
Telephone Lines Installed during Year (thousands)	212	236	263
Telephone Lines in Operation (thousands)	1,158	1,366	1,581
Telephone Density (per 100 population)	18	22	25
Telephone Traffic(millions of Impulses)	10,509	12,649	14,759
Telex Lines in Operation (thousands)	26	21	15
TELEPAC Circuit Connections (thousands)	7.0	10.1	10.6
Dedicated Circuit Connections (thousands)	12.5	14.5	16.0
Local Switching (Digital)	34 percent	48 percent	58 percent
Regional Transmission Switching (Digital)	76 percent	85 percent	88 percent
Interurban Transmission Switching (Digital)	44 percent	56 percent	68 percent
International Switching (Digital)	33 percent	48 percent	68 percent

(Source: Telecom Portugal, August 1993.)

Telefones de Lisboa e Porto (TLP)

TLP's network covers approximately 2,955 square kilometers and serves around 3.7 million of the country's population based in the Greater Lisbon (within 30 km of the center) and Greater Oporto (within 20 km of the center) regions. With only 3 percent of the country, TLP nevertheless serves a strategic market—namely, 37 percent of the population and 60 percent of the country's purchasing power; 80 percent of the country's major businesses, including head offices; and Portugal's political hub, TLP makes the claim that more than half of Portugal's telephone traffic originates from TLP's customers.

During 1992, 235,000 lines were installed under the local switching program and by the end of 1992, around 51 percent of TLP's network was based on digital technology. TLP has also been introducing digital transit switching equipment and aims to have achieved almost 100 percent digitalization by 1995.

The volume of traffic has been increasing rapidly over the trunk network, and to cater for this demand TLP has been installing fiber-optic cable and digital channels. All urban area exchanges are now connected by fiber-optic cable. Introduction of fiber-optic cabling in the local network is to be started during 1993. Table 2 gives a statistical overview of TLP's basic network infrastructure.

In terms of the fixed telephone service, TLP connected 137,000 telephone lines during 1992. The telephone density within the TLP's coverage area has increased considerably over the last few years, and since 1990 the figure has jumped from 34 to 40 per 100 population at the end of 1992.

At the same time, great efforts have been made to reduce the waiting time for connection, and at the end of 1992 this was down to less than four months—compared with over ten months in 1989. With a density of 2.9 public call boxes per 1,000 population, TLP is introducing cardphones (currently

accounting for around 25 percent of the total) and call boxes which accept ATM payment cards (around 16 percent at end of 1992). The TLP has also managed to achieve 89 percent of repairs to call boxes carried out within one day of being reported.

TLP is planning to introduce SDH [synchronous digital hierarchy] transmission technology. With the intention of launching two pilot networks in Oporto and Lisbon, TLP was asking for equipment suppliers during 1992. At the same time, the installation of two Metropolitan Area Networks (in Oporto and Lisbon) was planned, which would allow provision of data, voice, and image transmission at between 2 and 34M bps [million bits per second]—the project went out to international tender during 1992.

TLP: Network Infrastructure Statistics

	1990	1991	1992
FIXED TELEPHONE SERVICE:			
Telephone Lines Connected (thousands)	1,221	1,328	1,433
Telephone Lines per 100 Population*	34	37	40
Payphones (thousands)	7.9	9.1	10.4
Payphones per 1000 Population*	2.2	2.5	2.9
LEASED CIRCUIT SERVICE:			
Total Leased Circuits (thousands)	29.7	32.7	33.2
Data Transmission Circuits (thousands)	8.9	11.8	14.9
DIGITALIZATION:			
Local Switching (percent)	27	41	51
Transit Switching (percent)	63	80	90
INSTALLED INFRASTRUCTURE:			
Local Switching Lines (thousands)	250	286	235
Local Network, Operating Lines (thousands)	147	180	230
Trunk Network, Digital Channels (thousands)	62	64	82
Trunk Network, Optic Fiber (km pairs)	797	1,417	3,972

Note: * Corrected in accordance with 1991 Census published by the National Institute of Statistics (INE). (Source: TLP, 1993)

Marconi Communiacoes Globais

As the international communications carrier, Marconi Communiacoes Globais' network infrastructure is mainly submarine cable and satellite-based. As well as having several satellite earth stations and its own radio communications network covering Portugal, the Azores, and Madeira, Marconi Communiacoes Globais participates directly in over 20 submarine cables around the world.

During 1991/92, Marconi Communiacoes Globais extended its international network infrastructure through its participation in several major international ventures and agreements:

—Construction and maintenance contracts for the SAT-2 (South Africa-Madeira-Canary Islands), TAT-11 (U.S.A., Europe), and COLUMBUS II (Caribbean, Madeira, Europe) submarine cable systems in 1991, as well as contracts for the TAT 12 and TAT 13 systems in 1992. The Eurafrica submarine cable system was commercially launched in August 1992.

—Inauguration of several satellite earth stations including Sintra VI (for long-distance traffic) and Sintra VII and VIII (for business communications and broadcasting).

Marconi Communicaoes Globais is an active participant in international satellite organizations INTELSAT, INMARSAT, and EUTELSAT.

Data Communications

The PSTN [public switched-telephone network] supports transmission rates of 1,200 bps [bits per second] asynchronous full duplex and up to 2,400 bps asynchronous half duplex.

Portugal's X.25 packet-switched network, TELEPAC, started on an experimental basis in 1984 and opened to public service in 1985. Formerly known as Transdata, the TELEPAC network is operated by the TELEPAC consortium (established in 1992), which is a joint venture between Telecom Portugal and TLP—each responsible for operations in their respective geographical areas. Both public operators currently own an equal share, but it is probable that a third party may also eventually take a share. As well as data transmission services, TELEPAC also offers videotex services (launched in 1989) and private circuits on a non-exclusive basis.

The TELEPAC network is based around three main centers: Oporto, Coimbra, and Lisbon. Lisbon also has an international transit code. The network conforms to ITU-T (formerly CCITT [Consultative Committee of International Telephone and Telegraph]) recommendations X.3, X.25, X.28, and X.75 protocols. Access lines are available at speeds of up 19.2k (19,200] bps, 64k [64,000] bps, and 2M bps (in most central locations). Towards the end of 1992, the TELEPAC network served an estimated subscriber base of

around 10,000 for data transmission and videotex services. There are possibly plans to introduce frame relay technology into the network.

Equipment for the network infrastructure has been supplied by various companies including Northern Telecom and Nokia (through it's local distributor, Omnitecnica).

Mobile Communications

Portugal's first mobile cellular telephone network was set up in 1988 when the then CTT awarded Siemens a contract to install the infrastructure for a C-450 mobile radio system, called Telemovel. Since Telemovel was launched, there has been a change in the operation of public mobile communications with the creation of Telecomunicacoes Moveis Nacionais (TMN). TMN is a joint-venture company involving all three public telecommunications operators, and operates mobile services throughout Portugal—including the Telemovel cellular service.

More recently, there has been the award of two GSM operating licenses. The demand for the GSM service has been dramatic and within the first four months of operation there were more subscribers than the old analog Telemovel system had attracted in more than four years.

TMN was awarded the first GSM operating license and launched its GSM service in October 1992. It is now looking to expand its network infrastructure and in July 1993, awarded Motorola ECID a contract to supply equipment for this expansion. TMN is currently concentrating on coverage of the main commercial centers, i.e., Lisbon and Oporto, for which Motorola is providing sectored base stations. Coverage of Lisbon was due to be completed during Summer 1993. Infrastructure equipment (i.e., base station controllers, base transceiver stations, and an operations and maintenance center) have already been supplied by Motorola for TMN's service in the Algarve and Alentejo regions.

In August 1991, the Portuguese government awarded the U.S.-backed consortium, Telecel Comunicacoes Pessoais SA, the license to operate a private GSM mobile telephone network in Portugal. Telecel had been up against six other consortia in the selection process and was strongly criticized at the time for its unrealistically high investment and subscriber projections. At the same time, it also caused anxiety in the rest of Europe, that the chosen operator should be heavily influenced by its non-European backer, Pacific Telesis, which has a 23 percent stake. Telecel is a Portuguese company formed by two major Portuguese financial groups, Espirito Santa and Amorim. In addition to PacTel, the other shareholders are Centrel, Efacec, and LCC.

Telecel's nationwide GSM network was officially inaugurated in October 1992. At this initial stage, the network offered coverage to around 80 percent of the population and permitted the use of both transportable mobiles and handheld telephones. By 1996, the system should serve around 150,000 subscribers and cover 85 percent of the territory.

Ericsson won the contract worth US$150 million to supply the network, which is based on three switching nodes, three operation and maintenance centers, a network management center, and more than 100 base stations.

Paging

In 1990, with backing from Telecom Portugal and TLP, a new company, Telemensagem, launched Portugal's first public paging service, Telebip. The initial coverage area was Lisbon, Oporto, and part of the Algarve region. By the end of 1991, there were some 6,200 subscribers.

Portugal's paging market has since been opened up to competition from other operators, and as a result there are now a total of four paging operators, including Telemensagem.

In October 1991, the Contactel consortium, in which Marconi Communiacoes Globais has a 51 percent holding, took part in the tender for a nationwide paging license in Portugal, and in April 1992 the consortium was awarded a license to operate the Contact service. Other partners in Contactel are Telefonica (Spain) and Matrix (Australia).

The Ericsson subsidiaries, Sociedade Ericsson de Portugal and Ericsson Magnetic, won the contract worth US$4.1 million to install the infrastructure for Portugal's first privately operated paging system. There are three phases of installation: The first phase (completed early 1993) covered installation of 30 base stations and covered the metropolitan areas of Lisbon and Oporto, as well as some rural regions. The other two paging operators are Sinacom and Telechamada—both have been in operation since 1992.

Text Services

Portugal's telex network, divided into eight zones, covers the major cities of Lisbon, Coimbra, Braga, Faro, and Aviero, as well as the islands of Madeira and the Azores. The telex links to Madeira are over submarine cable and those to the Azores are via satellite.

The use of facsimile services has grown rapidly in Portugal over the last few years—at the expense of the telex service. Over 1992, there was a 33 percent growth in use. Telecom Portugal and TLP jointly operate the Corfac public facsimile service with offices located in the major cities.

One of Marconi Comunicaoes Globais' associate companies, Marconi SVA, launched commercial operations of an e-mail service—Email 400—in Portugal in July 1992.

ISDN [Integrated Services Digital Network]

Telecom Portugal's pre-ISDN service, Diginet, offers small and medium-sized businesses access to the public switched network through 2M bps digital links.

Telecom Portugal has been operating ISDN services to private companies on an experimental basis until the start of 1993. Both basic rate (2B+D) and primary rate (30B+D) access have been available. A commercial launch of ISDN was planned for Summer 1993.

TLP carried out a series of pilot trials in Lisbon and Oporto during 1991, with basic and primary rate accesses to a restricted number of customers to test new signaling protocols. TLP launched basic and primary rate access ISDN during 1992.

Both Telecom Portugal and TLP are committed to the introduction of Euro-ISDN and this was reaffirmed at a meeting of the 26 European operators in Bruges, Belgium, in

June 1993. The meeting was to finalize details regarding the launch of the European digital network, which is due in December 1993.

The Future

Portugal's immediate aims are to bring the telephone density level up to the European average as quickly as possible, as well as working towards removing the cross- subsidy that currently exists between the telecommunication and the postal services sectors. At the same time, increased competition within the various telecommunications market sectors is the way ahead and will be encouraged. It is envisaged that there will be a reluctance on the part of the public service operators to the changes that are likely to occur—particularly when the result will inevitably be an erosion of their market share.

Portugal is, nevertheless, moving in the same direction as the rest of Europe—albeit somewhat more slowly than most EC countries. In June 1993, the members states of the EC agreed to allow competition in domestic and international telephony markets throughout the region by 1 January 1998. Having one of the less developed telecommunications networks in the EC—along with Ireland, Spain, and Greece—Portugal has been granted an extra five years to modernize the network infrastructure before having to comply with the EC directive.

The move towards privatization of the operators is being undertaken in a controlled manner. With one single holding company for all three public telecommunications operators, the idea is to coordinate the gradual introduction of private capital into all of them—rather than throw the market open to competition. It is hoped that this will avoid the problem of the most profitable sectors being eagerly skimmed off to leave the state holding the remaining sectors. Although no timescale has yet been set, there is speculation that the privatization process will be set in motion during 1994.

France: Thomson Develops Multitrack Terabit Video Tape

BR2212094893 Paris SCIENCES ET AVENIR in French Dec 93 pp 74-76

[Article by Remy Deveze: "Video: The Multitrack Revolution"]

[Text] In the middle of the laboratory, a silver plinth is lit by a low angled light. The device standing on it is scarcely larger than a packet of cigarettes, but all attention is focused on it. The lack of a cover reveals an 8-mm-format video cassette. The electronics surrounding it would seem bare to anyone who has ever taken apart a home video recorder. Behind the plinth is a television. A man in a white coat standing in front of it operates the remote control. The screen shows successive clips of a Brazilian sitcom, the latest UB40 video, a cartoon, etc. At first glance, this is nothing extraordinary. Closer examination reveals, however, that the television is not plugged into any antenna, satellite dish, or cable network. The only wire coming out of the set runs into the curious device on show on its silver plinth. The engineer is flicking channels...on a video tape.

This kind of luxury may appear banal to blase consumers, but it is a real technological miracle. The device, a high-density video player and recorder, is capable of storing—on the smallest video cassette on the market, the Hi8—as much data as can be contained on 50,000 computer diskettes, 200 compact disks, or a semitrailer crammed with encyclopedias. The small marvel can also read one or more channels and simultaneously record about 10 others. Great, I will have one, you might say. Not so fast. The product is still kept under lock and key in Thomson CSF's Central Research Laboratory (LCR).

Located in the southeastern suburbs of Paris, between the Chevreuse and Bievre valleys, the world detection specialist's research and development sector employs 330 people. Everyday work here includes logical constraint programming, the study of submicron structures, and the design of millimetric transistors. Video cassette channel hopping was designed by the Magnetism Group, one of the laboratory's seven branches. Normally, this team works on applications closer to Thomson CSF's main sectors of activity, such as high-temperature superconductors, one of the most promising electromagnetic detection technologies.

Research sometimes finds openings on the consumer electronics market. Thanks to the Magnetism Group, Thomson already receives royalties each time a CD player is sold somewhere. This is because the two inventors of the compact disk, Philips and Sony, used some Thomson patents in the laser read head. The new video recorder falls into much the same mold. It is of interest to all sectors that need small-size mass memory storage devices, whether for the on-board electronics of a fighter plane or the space shuttle, in a desktop computer, or simply in the home. Indeed, ordinary TV lies at the root of the research project, with much speculation surrounding its future. In the hubbub of possibilities for the future, one thing is certain: Consumers always want more TV programs. Another certainty is that TV of tomorrow (or the day after tomorrow) will be digital. Video signals will be recorded, carried, and read as data bits, with sound and picture converted into huge packets of noughts and ones. In this way, picture quality should be improved and its format enlarged.

All this assumes that giant storage media are required to store the mass of data contained in a film, for example. A three-hour, high-definition, wide-screen feature film requires 10 to the power of 12 bits (one terabit). To fit this 1 terabit of data onto a small, already-marketed storage medium was the challenge taken up by the Thomson CSF researchers. They selected the Hi8 video cassette. Jean-Paul Castera, manager of LCR's Magnetism Group stated: "We are convinced that the future does not belong to optical film, whose recording capacity is limited by the laser wavelengths, but to magnetic tape."

Conventional video systems use recording heads attached to the periphery of a drum that revolves at high speed. This enables the data to be recorded on thin tracks laid out across the tape, and the relative speed between the head and the tape to be increased. Both aspects have considerably increased the recording capacity of video tape. In VHS, the track is 49 microns wide and the drum speed is 4.8 m/s [meters per second]. With the Hi8 system, the track width has been reduced to 18 microns for a speed of about 3 m/s.

However, with drum-based technologies, even if the track width were reduced to 5 microns, high-definition recordings would still require speeds in excess of 30 m/s. To follow such a thin magnetic track at a cruising speed of 108 km/h

[kilometers per hour] would require extremely precise and difficult-to-manufacture mechanics (drum and loading system). Jean-Paul Castera stressed: "Not only does the revolving drum pose a big headache at very high speeds, but it also generates major maintenance and vibration resistance problems for the on-board electronics." His team quickly fell back on a fixed head system, as used in tape recorders.

This choice meant that a number of other decisions also had to be made. Whereas conventional video recorders use a single drum to read from and write to a tape, LCR separated these two functions. The high-density device has two heads, one for recording and one for playback. Splitting these two tasks had two advantages. The first is of particular interest to film professionals who are today forced, once footage has been shot, to rewind the tape and play it back to check on the quality of the recording. With the Thomson system, the cameraman can check the recording "live." The second advantage is that a different technology can be used for each of the two functions. This is the aspect that researchers hastened to make use of.

While the principle is simple, it nonetheless took LCR three years to manufacture the matrix head. Recording so many gaps [preceding word in English] on such a small area is really quite an exploit. The result is there for all to see, however: LCR researchers have fitted 384 gaps in an area 8 millimeters wide and just a little longer, each one of which writes a track 18 microns wide. Now the new model, designed for VHS-type tape, is capable of recording 1,000 tracks 10 micron wide. This is enough to give a data transfer rate of 500 megabits per second, whereas the existing digital TV standard, MPEG [Moving Picture Expert Group], requires a throughput of 1.5 megabits per second. From a recording point of view, that is enough to store 333 films on one VHS videotape.

That is not all. It is not enough to simply record—the new system has to maintain the rate during playback. To meet this second challenge, the Thomson researchers invented a device that combined optical and magnetic modes. Jean-Paul Castera revealed: "Actually, we were lucky enough to find two conventional microelectronic components that corresponded exactly to what we were looking for: The laser diode and the charge coupled device (CCD). The former is widely used in compact disk drives and the latter is used in camcorders."

By combining these modestly priced and now common-technology components, the LCR team reached its goal of storing on one of today's conventional video cassettes a data transfer rate suitable for use with the television of tomorrow. In 1989, a demonstration device was presented at the Geneva physics fair. With electronics reduced for budgetary reasons to one-third of the capacity of the heads, it was already capable of recording three TV channels in a digital format on a Hi8 cassette. With the new 1,000-track matrix head, this prototype is already something of an ancestor.

This could be the start of a beautiful story. However, while the LCR researchers continue with their work, marketing constraints give them little hope of gaining their reward. While recognizing the merits of the high-speed device, Thomson's consumer electronics branch believes it to be a professional "niche" product (detection, aviation, electronic document management, etc.), rather than one destined for the vast home video market. The arguments put forward are that the system is not yet completely ready, optical memory has yet to show all its potential, and, above all, the standards set for the end of the nineties will very probably be for rotating head technology.

Forty million VHS machines are sold in the world each year. In this context it is difficult to impose a standard which, even if it uses the storage media available on the market, is not compatible with any other existing equipment. Moreover, Japanese researchers have not given up trying to improve the data transfer rate of VHS and other Hi8's.

All this explains why Thomson Consumer Electronics is taking a cautious stance, although it continues to finance part of Jean-Paul Castera's work. It is also true what they say about once bitten, twice shy. The European electronics industry has just come out of a bruising encounter with high-definition television [HDTV], and certainly does not want a repeat of the D2Mac [European transitional analog HDTV standard] syndrome. The little technological miracle risks spending a long time confined to those confidential places like the central computing system of an aircraft, a submarine, or the space shuttle. Patience is required.

How It Works

Matrix Writing

The gaps are laid out in a grid like the pixels of a CCD. To eliminate parasitic interference from neighboring points, the data comes from two sources. The current passed through air gap is the sum of the current coming down a column and the current coming along a row. The magnetic field generated by a gap is the sum of fields generated by these two currents. The field then writes a data bit if its value is greater than the minimum recording threshold for the tape. The trick lies in setting the two currents to values separately less than this threshold but whose sum exceeds it. Thus they leave no parasitic trace on the neighboring heads when their sums record the piece of data on the required place on the gap. This is the principle of "multiplexed addressing."

Read Process

The CCD consists of a grid of thousands of small pixels. These pixels convert light into electricity. A device regularly collects the electrical signals coming from each pixel. The optical image is in this way converted into an electrical signal.

To adapt this technique to magnetic reading, Thomson made use of the Kerr effect. Take laser light, for instance. It is polarized, meaning that all the vibrations making it up are synchronized and are moving in the same direction, unlike sunlight. This is a bit like the difference between a well-aligned battalion of soldiers marching in step and the chaotic movement of the crowd in the subway. When laser light is reflected off the tape through a Kerr effect transducer, the polarization of the rays changes depending on the magnetic orientation written onto each point on the tape. The soldiers are still marching in step and in line, but some are leaning forward and others are leaning back.

Then all that remains is to send the laser beam back to the CCD sensor by placing a polarizing filter in its path. The battalion's final destination is a large grid where each soldier has his precisely assigned position—but the ones that are

leaning backward are intercepted and sent down a hole. As a result, the grid is an image of the magnetic signals recorded on the tape. The operation is repeated several tens of times per second. Once they have been decoded these signals represent images and sounds.

Euro-ISDN Telecommunications Network Links 17 Countries

BR0401093994 Brussels LE SOIR in French 15 Dec 93 p 6

[Article by Philippe Berkenbaum: "The First Information Highway"]

[Excerpts] The "information highways" so dear to the president of the European Commission did not wait for the publication of his "White Paper"—adopted last Saturday at the Brussels summit—to become a reality. Yesterday, still in Brussels, Jacques Delors was to have inaugurated the first truly trans-European telecommunications network: Euro-ISDN (Integrated Services Digital Network). Prevented at the last minute from attending the ceremony, the Commission president charged the director general of DGXIII (EC Commission directorate general responsible for telecommunications) to represent him and to welcome the event on his behalf: "We are moving from the industrial era to the age of information." [passage omitted explaining ISDN technology, applications]

ISDN has remained relatively confidential until now for two reasons. The first reason was the national and incompatible nature of the early networks, leading to a lack of crossborder services. The second reason, an immediate consequence of this, was the scant enthusiasm shown by terminal manufacturers and service suppliers to invest in a market that was certainly promising but which was too limited because of the adaptations needed for each country.

It was to remedy this problem that, in 1986, the EC launched the idea of a jointly operated and standardized ISDN. Three years later, in 1989, 26 European telecommunications operators (including Belgacom) undertook to provide a basic set of pan-European services by the end of 1993. They rose to the challenge, and Euro-ISDN was born. The network already connects 17 countries. Including the vast investments needed to develop the applications, the global cost is estimated to have already reached ECU 50 billion or 2,000 billion Belgian francs. [passage omitted]

Some people, however, are wondering if Euro-ISDN is not arriving just a little late. It is merely foreshadowing the future network known as broadband ISDN, which is expected to be introduced on a large scale as of 1995. This network, also backed by the European Commission, will offer much greater data transmission capacities and a better integration of services. Bringing high-resolution color faxes, high-definition interactive television, the transfer of medical images, etc., it will pull Europe headlong into the era of multimedia communications. Pilot projects already exist, developed by the major manufacturers with the backing of various European programs.

The ambition stated in Brussels last weekend is to free up the resources needed to put these services within everyone's reach by building trans-European networks. In its White Paper, the Commission reckons that the development of telecommunications in Europe will cost some ECU 150 billion over the next five years. To be sure, such expenditure will not be in vain—by the year 2000, telecommunications should represent six percent of GNP of the Twelve and boost growth by six percent over the next 10 to 15 years. Its depths have yet to be plumbed.

UK-Japan: 30,000-km Optical Fiber Cable to Link UK, Japan

94WS0059B Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 14 Oct 93 p 8

[Article by "P.O.": "30,000-km Optical Fiber Cable From England to Japan. Consortium of Companies Will Invest Around $1 Billion/Additional Partners Conceivable/Price Differentiation According to Market Conditions"]

[Text] London—A multinational consortium of companies under American leadership is presently preparing to run the first optical fiber cable from Great Britain to Japan. Gabriel Yackanich, president of the FLAG Consortium in London, has reported that this telecommunications link will be put into service at the beginning of 1996.

Exploration work for the precise routing of the cable is being performed already now by quite a number of ships. Yackanich estimates at "around $1 billion" the total cost of this 30,000-km-long optical fiber cable link between West Europe and the Far East.

While there are already cable links both across the Atlantic and Pacific, which each permit 400,000 to 450,000 simultaneous telephone connections (with at the same time a multitude of call capabilities), according to Yackanich the route between Europe and the Far East has been developed only extremely poorly in most national sections.

There are only around 17,000 telephone links via cable in national sections here. This applies to the Near East and across the Indian Ocean, for example. The new cable having a capacity of 120,000 connections, permitting as many as 600,000 telephone calls simultaneously, accordingly means multiplication of the intensity of offered telecommunications traffic.

The name FLAG in this connection stands for Fiberoptic Link Around the Globe. However, it is not yet possible to predict whether this cable will one day really encircle the earth. For example, the fact that New York and London are not linked with one another via the FLAG cable has not least legal reasons that are a consequence of restrictions on telecommunications companies in the United States. Nevertheless, its continuation (to America or Australia for example) has by no means been ruled out, as was intimated in London.

The FLAG cable is to have 13 stations to begin with. It will begin with Great Britain and extend through Gibraltar, Italy, Egypt, Saudi Arabia, the United Arab Emirates, India, Thailand, Malaysia, Indonesia, Hongkong and Korea to Japan. However, additional terminal connections have by no means been ruled out.

The active selling of cable capacities to potential customers will begin soon and is to be concluded in the middle of next

year. Here it will essentially be a question of postal, telegraph and telephone and telecommunications administrations as customers for FLAG, as Yackanich expressly emphasized. In contrast to its satellite competition, the FLAG Consortium is emphasizing above all the interference-free service of underwater cable.

At the same time FLAG is banking on a different kind of marketing policy. In contrast to the usual pricing in telecommunications, the absolute distance of a communication via the FLAG cable will play no role with regard to its price. Rather the "price differentiation" will be done just according to market conditions, and thus according to the demand. Here Yackanich drew a comparison with the pricing policy of the airlines, whose prices in broad sectors also depend not in the least on the distance.

Thus far four without exception private-sector partners belong to the FLAG Consortium. They include—from the United States—the Nynex Corporation, which is involved almost exclusively in the telecommunications business, and Gulf Associates, an investment firm.

The Near East partner is the Dallah Al-Baraka business group of Saudi Arabia, and, finally, the Japanese partner is the Marubeni Corp. business firm of Tokyo. The inclusion of additional partners, from the Near East for example, is considered very likely, however.

It is worthy of note from the service viewpoint that the link between the Mediterranean and the Red Sea will have redundancy for security reasons. An additional land cable is to be laid as a standby, besides the FLAG underwater cable that will run between Alexandria and Port Said and on to Suez.

European Cordless Telephone Standard DECT Profiled

94WS0111A Heidelberg NET—NACHRICHTEN ELEKTRONIK + TELEMATIK in German Nov 93 pp 510-511

[Article by Manfred Schmitt: "All Ways Open"]

[Text] Due to the growing demands for accessibility and the ability to communicate and the traffic and environmental problems resulting from the mobility, there will be a continuing trend toward mobile communication and toward transportation of the information instead of the person. These developments apply to all areas of life. At the behest of the European Commission, the DECT standard was developed for the wide application field of cordless telecommunication of voice and data in order to access local mobile networks.

The DECT standard (Digital European Cordless Telecommunication) represents an evolution based on the previous industrial (CT0) and public standards (CT1/CT1+, CT2 as interim ETSI standard). With its special targeting of mobility at the office and at home, it is increasingly used as a method of network access for private branch exchanges and the analog telephone system, as well as for wide-ranging mobile communication of voice and data. European manufacturers of telecommunications facilities such as Siemens, Alcatel, Ericsson, Philips and Nokia have committed themselves to use the DECT standard and corresponding products are being developed or are already available.

The DECT standard was defined and developed by ETSI (European Telecommunications Standardisation Institute) beginning in 1989 and was adopted in July 1992. The EC signature nations have obligated themselves within the scope of an EC guideline to introduce DECT by 1995 and to provide the required frequencies, as well as to make the necessary permit regulations available on a voluntary basis within the framework of an EC recommendation. The DECT standard defines a transparent, digital aerial interface between a mobile unit and a base station for cordless telecommunication of voice and data over analog telephone networks, ISDN [Integrated Services Digital Network], GSM [not further identified], package and wire-transmitted data networks as well as local area networks.

Because of the Europe-wide application area, large markets with enormous quantities are open to DECT, which makes rapid and major reduction in technological and production costs possible through scaling effects. Market demands, rapidly dropping prices, versatile application, combined with diverse advantages from the user's aspect, form the initial basis for successful opening up broad mass markets for DECT in Europe and beyond. In November 1992 the Federal Office for Posts and Telecommunication issued the German licensing regulations for DECT systems and end equipment and thus made the market introduction of DECT products possible on a broad basis.

Advantages for the User

The advantages of DECT for the user derive, on the one hand, in general from the use of powerful mobile communication at home, at the office and in the future from public access as well, such as high accessibility/availability/communications ability, mobile internal communication free of charge, increased action/reaction speed, accelerated decision-making, faster transaction processing, liberal waiting times for important calls, higher measure of service, lower number of unsuccessful calls, cost/time advantage because fewer return calls are required, freedom of mobility during the connection and cost savings when moving.

On the other hand, many user advantages are the result of the technical concept of DECT, such as high communications quality through 32 kbit/s speech coding and continuous channel optimization, high security against wiretapping including through optional speech coding, high radiotechnical area coverage and space illumination, mastery of large subscriber numbers or traffic density, roaming (localizing the subscriber through all radio cells), simple installation and expansion without frequency planning, the ability to integrate voice and data as well as investment security because of a promising standard and simple expansion possibility of the system.

Technical Features

DECT is a cordless access method to target networks such as the public analog telephone net, the ISDN net and in the future also the GSM net. DECT offers the technical basis for application-specific system solutions or special DECT profiles in the form of a transparent aerial interface (Layer OSI 1 through 3). DECT's protocol supply includes all procedures for realizing cordless end equipment and systems (authentication, speech encoding, mobility management) as

well as all important standards and protocols of telecommunication (ISDN, LAN, X.25, X.400...) for cordless telephones and branch facilities for the home, office and in the future also for public networks (public access).

DECT Profiles and System Solutions

DECT's extensively defined protocol supply enables definition and specification of application-specific system solutions for voice and data as well as access through the DECT aerial interface to various target networks such as GSM, ISDN with upstream DECT systems or base stations. According to an EC recommendation, these kinds of DECT mobile units should be able to work with various DECT profiles or system solutions (common interface).

The voice-oriented DECT standard ETS 300175 (Common Interface) and ETS 300176 (Approval Test Specification) were adopted in July 1992 by ETSI and made available to the public. At present a series of additional DECT profiles are operating at ETSI, for which stabile drafts will largely be available in 1993/94, which can then already be used for development activities. DECT-GSM Interworking enables the cooperation of DECT mobile units with DECT systems which are connected to GSM systems; DECT-ISDN Interworking permits the cooperation of DECT mobile units with DECT systems connected to ISDN systems; DECT Data Profiles enables data transmission between DECT mobile units and DECT systems; DECT Generic Access Profile (GAP), based on PAP (Public Access Profile, ETSI Draft TBR 11), defines a public standard interface for access from DECT mobile units to various fixed networks which take the mobility requirements into consideration (probably available after 1995).

Application Areas

At home, in small businesses and for the self-employed, monocellular cordless telephones and cordless small branch exchange facilities based on the DECT standard offer convenience and flexibility in the house and garden, in the home office and small business, with all the described advantages of mobility with excellent communications quality and wiretapping security. And this at a price level comparable to significantly simpler analog products. Here it is primarily accessibility at all times as well as the ability to be able to call at any time and everywhere in the house, garden and business sector, without charge between persons using internal communication or externally via the exchange at normal charges. With the available data capability of up to 19.2 kbit/s and with small systems as well, interesting solutions are available particularly for the home, because it is possible to be in contact by computer with voice and data networks from any arbitrary place within the range of the system without installation of cables and telephone extension units, in parallel with other internal and external conversations.

In larger organizations which cover a correspondingly larger area or space and have their own PBX facility, powerful multicellular systems are offered. By means of overlapping radio coverage of surface and spatial building structures it is possible to assure mobile communications ability, receiving and transmitting, fixed and mobile, through continuous localizing of the mobile units in the system range (roaming) and automatic, interruption-free connection of conversations when changing from one cell to another, all the while with a high quality of communication. Because of the mobile subscriber's capability for active and passive communication, he obtains the advantages already mentioned such as rapid reaction capability, faster decision-making and increased productivity. In connection with a private branch exchange the mobile subscriber gets the performance features of the PBS, with the free internal communication which is so important particularly for business applications and which is also available in mobile form, and the external communication at normal charges.

In the office sector, data applications are also gaining in importance. Here the data capability of DECT by no means replaces the high-performance Local Area Networks. DECT's data capability of up to 30 kbit/s, initially in the lower speed range, covers the important portion, estimated at 80 to 90 percent, of internal and external data communication at the office with a volume of up to 10 kbytes per operation. This fully maintains the advantage of being able to transmit speech and data at the same time over the same base station. By establishing a special data profile (DECT-DATA profile) through ETSI, pure data transmission speeds of 1 Mbit/s, in some cases also significantly higher combination values, can be achieved.

In the public area, above all at special social focal points such as pedestrian zones, shopping centers, athletic stadiums, airports, railway stations, etc. with a defined area and a high traffic density, the DECT is the more suitable solution compared to GSM, since with 10,000 Erlang units per square kilometer significantly more subscribers can be served (GSM: about 200 Erlang units per square kilometer). This requires the establishment of a minimal common interface for DECT, however, which at present is being used under the working name of Generic Access Profile/Public Access Profile at ETSI.

In the areas covered by the radio technology the DECT profile GAP/PAP then enables access to PBS systems (and the use of the entire range of functions thus provided) as well as public analog networks, ISDN and GSM networks through integrated DECT subsystems. Since GAP/PAP will become an integral component of the DECT standard, it will then be possible, with one and the same mobile unit, to communicate via the house base station of the cordless DECT telephone or small system or through the multicellular DECT office system or via a public base station. In connection with the compactness and ease of the DECT mobile unit, this sum of possibilities comes very close to the ideal picture of a "personal communicator" which everyone can afford, which can be carried everywhere and enables you to communicate everywhere, at any time and with everyone.

German Links to International Globand Network Discussed

94WS0111B Heidelberg NET—NACHRICHTEN ELEKTRONIK + TELEMATIK in German Nov 93 pp 499-501

[Article by Hans Herr: "Bridge to Broadband ISDN"]

[Text] Globand is the name of a new network which is now available worldwide. It supports transmission speeds of between 64 kbit/s and 2 Mbit/s and is suitable primarily for

undertaking services with large quantities of information. One principal application will be the videoconference service which Telekom will switch from the Transmitted Broadband Network to the Globand network at the end of 1993.

The starting point for the development of the Globand network was the European Community's RACE (Research and Development for Advanced Communications in Europe) program. Within the framework of the European Broadband Interconnection Trial (EBIT) project innovative data applications were to be realized, for which a suitable data network with a bit rate of at least 2 Mbit/s was needed.

The EC in 1988 asked the CEPT (Conference Europeenne des Administrations des Postes et des Telecommunications) whether it was able to supply within a short time such a transparent switched data network with the existing technology. As early as April 1989 19 Telekom organizations from 14 European countries signed a corresponding Memorandum of Understanding (MoU). DBP Telekom, which was also among the signatories, participated in the project with the satellite-supported, area-covering DFS network (German Telecommunications Satellite).

In the course of the test preparations it turned out, however, that only very few applications actually needed 2 Mbit/s; in most cases 64 kbit/s were enough. The signatories therefore decided to halt the Ebit project. Those participants who had already made investments for adjustment work and calculated their market opportunities signed a new MoU in March 1992 and together formed a consortium which was given the name of GloBanD (Global Bandwidth on Demand).

By July 1993 network operators from Finland, Norway, Denmark, the Netherlands, Belgium, Great Britain, Switzerland, Portugal, Hong Kong and Australia had joined the consortium. Telekom participates as a so-called associate partner, since the technology it supplies does not permit full partnership according to the MoU.

User Facilities and Applications

The Globand network offers the customer the following user facilities:

- Switched connections,
- bandwidth on demand
- bit transparent transmission with a speed of n x 64 kbit/s (n=1, 2, 4, 6, 8, 12, 23, 24, 30),
- customer interfaces G.703, V11, X.21, Q.931W (planned),
- closed user groups,
- point to multipoint connections,
- reserved connections.

This list makes it clear that the Globand network belongs to the Corporate Network category. To be sure, some user facilities for traffic relations with the German network component are not offered for technical reasons:

- Bandwidth on Demand is not available through the customer in the DFS network, but is switched on by request by the operator;
- at the moment only transmission rates of 384 and 1,920 kbit/s are offered;
- no reserved connections;
- no closed user groups.

Globand is suitable primarily for the following applications:

- Self-dialled videoconferencing including multipoint conferencing;
- rapid data transmission, for example between host computers;
- LAN-LAN coupling;
- remote printing and setting;
- back-up for rented lines or overflow traffic;
- audio lines for hifi transmission;
- remote consulting and diagnosis in the medical field;
- CAD/CAM (Computer Aided Design/Computer Aided Manufacturing).

The main application of the DFS/Globand network will be the videoconference service. At Telekom this service will for technical (selection ability) and cost reasons (charge standardization) be switched at the end of 1993 from the Transmitted Broadband Network (VBN) to the DFS network.

From the DFS Network to the Globand Network

The Globand partners are using exclusively terrestrial networks. The DFS network, on the other hand, is a satellite-supported, digital switched network with transparent data channels. It consists of 30 connection stations with the transmission-technical installations, two reference stations for network internal control purposes and one operating control center.

The connection stations are operated unmanned and remotely serviced and monitored. They consist of the antenna reflector with the IF/RF installations (intermediate frequency/radio frequency), the TDMA installations (Time Division Multiple Access) for allocation of satellite transmission capacity and the communications unit (ANPE, adapter unit) for the network connection. This consists of 24 2 Mbit/s ports, which if needed can be divided into entry and exit ports. The technology is based on the S12 system from Alcatel SEL.

The communications facilities are in part also terrestrially interlinked. This was necessary because of the transfer of the videoconferencing service to the DFS network and the resulting danger of overloading. For the subscribers this has the advantage that they can get a terrestrially routed connection if they want to avoid potentially undesirable delay time on the satellite link. Moreover, the transition to foreign networks also takes place through the communications facility.

The network terminus is located at the subscriber's and is connected through a 2-Mbit/s connection line to the communications facility. The switching procedure takes place either software-controlled with a commercial PC or with the keyboard of a commercial multifrequency selector telephone.

With the exception of the German component, the Diax concept is used in the Globand network. This network concept, named after the Danish company with the same name, consists of three components:

- The local transmission station (Vst) can accept up to 22 2-Mbit/s connections. It can be operated as a stand-alone Vst or as a part of a larger network.
- The Transit-Vst can process up to 80 2 Mbit/s PCM systems and supplies the necessary functions of a

gateway station. It is comparable to the ANPE in the DFS network.
- Dikonet 64 and 2000 form the network terminus for 64 kbit/s and 2 Mbit/s.

With junctions to networks with a different technology (such as the DFS network), the Transit-Vst must be modified at the gateway station in question for the required performance characteristics in the entire Globand network. This is done with new software releases.

The principal difference between the DFS network and the infrastructure of the other Globand partners lies in the signaling: Both technologies make use of the CCITT-No 7 system, with a central time division channel. The Diax technology uses the so-called Telephone User Part (TUP) for this, while Telekom uses the so-called Data User Part (DUP).

The required adaptation functions are in each case implemented in the transmission nodes of the gateway stations for the immediately adjacent network components. In the case of the German network component, this is ANPE. These functions are supplied at the stations in Hamburg, Duesseldorf and Offenburg. Ultimately, the performance characteristics of the network junctions determine all the services offered by the network. Thus, the offering of German network components can be expanded within Globand if the corresponding modifications are introduced into the ANPE of the gateway station and the foreign network junction in the immediate vicinity. As an example of this the supply of additional transmission speeds (in addition to 384 and 1,920 kbit/s) is mentioned.

A central operating control center for the entire network is not necessary. Each network component has its own center available, which in addition is equipped with a Globand help desk. Operating, monitoring and error elimination are integrated into the overall concept of the respective network operator.

Standards for the Competition

The international call number in the Globand network consists either of the Country Code (CC) or the Data Network Identification Code (DNIC), including the national portion. Call data postprocessing takes place at the operating control center. Accounting for the international charges takes place only between the directly adjacent network operators and according the rules of the telephone service.

The quality of services can be specified with respect to the connection and the customer service. For network operators who support the complete palette of Globand performance characteristics, the following examples of values are to be understood as standards to be aspired to.

Connection parameters:

- Bit error rate: 10^{-6},
- max. delay time (without satellite): 200 ms,
- connection setup time: 12 seconds,
- lost calls: 0.4 percent.

Customer service:

- Installation time for the connection: 90 days,
- length of time for interference suppression: 36 hours,
- manning of the "help desk:" official service hours,
- malfunction reporting: around the clock

Telekom regards the DFS network in the Globand network as a transitional solution until broadband ISDN (B-ISDN) based on ATM (Asynchronous Transfer Mode) is ready in about three to four years. After that, it can be employed as a backup for B-ISDN, if necessary. The other Globand partners position their network components in the same way.

Transmission speeds similar to the Globand network are also offered by the narrow band ISDN (S-ISDN). When using inverse multiplexers for bundling B channels, for example, the service quality of S-ISDN for bit rates over 128 kbit/s will be below Globand's, however.

Turkish Fiber Optic Links to Balkans, Elsewhere

94WS0112A Athens TA NEA in Greek 1 Nov 93 p 22

[Report by Takis Kambilis: "Telecommunications Blockade"]

[Text] For almost two years now, the Turks have been planning a telecommunications blockade of Greece from the Balkans and also from the geopolitically important region of East Europe and the Middle East.

Already, three ultramodern fiber optic nets are being built by Italy and Turkey for the purpose of linking the European Economic Community to the Balkan countries and to the former Soviet republics on the Black Sea and the Caspian Sea.

The central point of these nets, that have major economic significance, will be Istanbul. According to the plans, not one of these nets will pass through Greece. As experts explain, the result will be Greece's being cut off economically from these regions—and, in fact, from the Balkans—since it is evident that ultramodern telecommunications constitute a prerequisite for every form of economic and social development in modern societies.

More specifically, one of the three nets, that is expected to be put into service in about a year, will link Bari, Italy, with Tirana, Skopje, Sofia and Istanbul, leaving Greece completely out of the planning.

Prof. Kostas Makropoulos, former OTE [Greek Telecommunications Organization] and community specialist on telecommunications issues, was the one who revealed the details of the plan and the dangers posed for Greece from a telecommunications blockade. He attributed responsibility to the previous government since the agreements involved were signed in December 1992 and the technical projects inaugurated in May 1993.

Mr. Akis Tsokhatzopoulos, PASOK [Panhellenic Socialist Movement] secretary general, has already been informed on the matter, while a relevant file will probably be given to Minister of National Defense Yerasimos Arsenis today.

The Plans

Specifically, from the relevant documents and maps, it appears that on 2 December 1992 contracts were signed for the implementation of the three plans to set up a telecommunications infrastructure lasting 25 years. The ITUR links Italy with Turkey and Ukraine with Russia. This net starts out in Palermo, goes to Istanbul and from there, via Ankara, heads for Odessa (and Novorossiisk, Russia). Its length is 3,500 kilometers, while it is expected to go into service at

the end of 1995. The technical meeting took place on 25-28 May 1993 and the second that took place a month ago concerned the building of five pairs of fiber optics at 565 MB/sec with 38,400 circuits.

The second plan that is called DOKAR concerns the linking of Istanbul and Ankara with the eastern shores of the Black Sea. Its two other big stations are Tbilisi and Baku.It also has the same huge capacity of 565 MB that, however, abruptly drops to 34 MB when the net reaches Georgia. It has been planned to go into operation sometime in 1994.

The third (and best) net is the Trans-Balkan Link. It begins in Bari and goes to Durres, Tirana, Skopje, Sofia, Sliven and Istanbul that is the central city station for all three nets. The relevant agreement was signed five months later, on 6 May 1993. We have here 1,920 140 MB circuits and 7,650 622 MB circuits. Beginning of service is also planned for sometime in 1994.

Finally, there are also plans for linking the Black Sea shores that include Romania.

Northern Cyprus

Besides the Balkan telecommunications arc that is being promoted, the Turks have also included another fiber optic net that will link up with Turkish-held northern Cyprus.

As Mr. Makropoulos explained, the Turkish plan constitutes one of the most developed forms of an exercise of political and economic pressure that is founded on the development of new technologies. The country that will constitute the central telecommunications junction of a major geographic region not only will earn billions of dollars from the use of this net by third parties but it will automatically acquire a privileged entry into the countries that will be linked with Europe.

Mr. Makropoulos further explained, "Fiber optics today constitute the linchpin of the community's telecommunications policy for the coming decades. This is so because they are much cheaper than satellites and have much greater capacities. In other words, they are able to send to another given region images, sound and information in the shortest possible time. I will cite as an example that a 140 MB net can send information on 7,500 typed pages in the space of one second!"

As Mr. Makropoulos said, all the added value services are based on these nets as are the rapid development of activities such as tourism, trade, technical projects, cultural relations and, finally, privileged entry of a given country into third countries since the latter depend on—in this case—Turkey.

The cost of the investment is big but for this too, according to Mr. Makropoulos, there is expectation for community subsidies!

Mr. Makropoulos added, "Unfortunately, these facts reveal how the New Democracy party exercised such an unrealistic and nationally dangerous policy in a field like telecommunications."

Germany: Pilot Plants Developed to Recycle TV Picture Tubes

94WS 0099a Munich FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 05 Nov 93 p 8

[Unattributed Article: "Fully Automated Recycling of Picture Tubes—Two Pilot Plants Recycle Sorted Glass"]

[Text] A new, fully automated recycling process is to prevent TV and computer picture tubes from being deposited in hazardous waste dumps. Hetzel & Co Elektronik-Recycling

GmbH and the equipment technology division of Siemens AG presented two pilot plants in Nuernberg which dismantle both black-and-white and color picture tubes into completely sorted glass. According to Hetzel CEO Juergen Wolf, ten million picture tubes per year are being discarded in Germany.

According to the company the program-controlled facility uses a thermal process to separate the lead-containing conical glass and the strontium-containing front glass. Test agreements exist already with the glass industry to reuse the recycled products for picture tube molding. Black-and-white tubes which consist of uniform glass are cut open with diamond saws in the pilot facility which makes it easier to remove the luminescent coating in a washing installation.

According to the company, there are also plans for recycling the washed out rare earth elements which currently still go to a waste dump. At present, the two mobile facilities recycle 240 color tubes and 150 black-and-white tubes per day . According to Wolf, this throughput can be increased quite easily. The unit price for recycling a tube is currently DM8, for a complete computer monitor it is DM35 to DM45.

EC To Propose 16/9 HDTV Format Directive

94WS0153C Paris AFP SCIENCES in French 25 Nov 93 p 11

[Article: "New EC Proposal on HDTV Transmission Standards"]

[Text] Brussels—The European Commission [EC] is going to propose a new directive (Europe-wide law) on high-definition television (HDTV) to promote popularization of wide-format television (16/9 width-height ratio) that will be applicable independent of the transmission standard used, according to Community sources.

This new proposal follows the Twelve's decision last June to promote wide-screen television in the HDTV action program and abandon any reference to a single, mandatory transmission standard. Initially, the Commission had planned to make the D2-MAC and High Definition-MAC (HD-MAC) standards obligatory.

The new proposal, to be submitted to member states on 7 December, provides that television services transmitted to viewers by cable, satellite, or ground-based broadcasting stations must utilize either D2-MAC or a transmission

system 100 percent compatible with PAL or SECAM standards. Among other things, that should permit use of the German "PAL Plus" standard now under development.

For services not fully digitized, the Commission proposal endorses the HD-MAC transmission system. Experts expect digital transmission standards to evolve rapidly in the coming years. The Commission stipulates however that digital transmission systems will have to be "standardized by a European standardization body."

The proposed directive also says that "any wide-format (16/9) television service that is picked up and rebroadcast by cable systems must be rebroadcast in the wide (16/9) format."

Germany: Mobile Communications Improvement Planned for Eastern Germany

94WS0164A BERLIN INGENIEUR DIGEST in German Dec 93 p 32

[Article by Ulrike Scholz: "The Aura of Elegance"]

[Text] The development of telecommunications has been a success story in eastern Germany. The second privately operated mobile communications system is scheduled to go into operation in early 1994. The system will be operated in the Berlin and Leipzig regions.

Herbert Brenke complains that "whenever E-Plus looks for sites for its transmitters, it finds that D1 and D2 have already been there." The managing director of E-Plus Mobilfunk, the third largest mobile communications company, knew as early as April 1993 what lay in store for him. He would have to try to operate in the same market that his competitors Telekom and Mannesmann had entered two years earlier.

The launching of the new system is to be in eastern Germany, where the need to catch up in the communications field is still great. The inauguration of services in Berlin and Leipzig simultaneously signals the rapidity with which the networks between Ruegen and the Thuringian Forest will be connected up.

Since unification, Telekom has accomplished an incomparable feat in East Germany. In its "Telekom 2000 Program," this government-operated company set forth the schedule according to which the state-of-the-art of communications in the new federal states was to be brought up to the level existing in West Germany.

Telekom is already way ahead of its own schedule. It will conclude work on the digital communications system this year. In the first half of 1993 alone, 540,000 customers in eastern Germany were provided with telephone service, i.e., 53% more than in the entire previous year. Some 3,500 public telephones were installed this year, mostly in rural areas; 12,000 phones had to be replaced, 5,000 of which were inoperable.

The rapid tempo was made possible by the expeditious installation of most of the digital trunk node exchanges and the 500 local digital exchanges. Every second local network was substantially expanded and modernized. In late September, Quedlinburg and Gera became the first cities in the world to have a fiber-glass system in operation.

"These are the kind of accomplishments that bring the company considerable favorable recognition from abroad," Dr. Wilhelm Paellmann, Telekom board member, said. With its 11 billion German marks [DM] invested, Telekom is the greatest single investor in the new federal states this year.

A considerable volume of the tasks in data and mobile communications has already been resolved. Telekom established its mobile communications sector this summer. The 100% subsidiary is called "DeTeMobil." It is designed to make D1-system users more flexible. D1 has at least 315,000 customers in Germany. However, neither the subsidiary nor the parent company enjoys the profits, since all proceeds go into the common Post Office pot. Nonetheless, Brenke, the head of E-Plus, has to reckon with both governmental as well as private mobile communications competition. He has to operate with another handicap as well. While the D-systems operate in the Global System for Mobile Communications Standard at 900 mHz, the E-Plus system is designed for a frequency range of 1.8 GHz. It transmits and receives in the Standard DCS 1800 (Digital Personal Communication System). However, given the same transmitting power, the range of the higher frequencies is less. Consequently, a transmitting and receiving station in the E-system can only service a smaller area than one in the D-system.

In its final expansion, E-Plus will have 4,000 to 6,000 cells in Germany. Even Brenke doesn't know the final number yet. It depends on the locations of the base stations. In large cities, the radius of operation is between one and three kilometers, while in a flat landscape it can be up to 20 kilometers.

Brenke's wish is for infrastructure-sharing: "We would gladly share transmitting masts and other facilities with our competitors." Unfortunately, the market is a battle field. The head of E-Plus is now hoping for a developmental breakthrough in the matter of base stations and mobile telephones. He expects smaller, lighter, and more powerful equipment and facilities so that he would not have to incur the same expenditures as his two competitors.

Brenke knows that there are also certain advantages when one enters the market later. Potential customers have already accepted mobile communications. In addition, the technology has already matured and been perfected and can be procured at cheaper rates. In late October, ESCOM offered Motorola's International-3200 Handy along with the D2-card for a measly DM389. This offer could drive the second million mobile communications customers, who have been waiting for digital systems and cheaper equipment, into the open arms of E-Plus Mobilfunk GmbH.

But even this order of magnitude does not satisfy the ambitious Herr Brenke at all. In the year 2000, ten million customers will be using mobile communications systems in Germany. Brenke will have a large part of them. His marketing strategy is to open up new layers of buyers. "Mobile communications must assume the certain aura of elegance. If they are to be considered affordable, the potential private customers will have to be convinced that the mobile telephone will create new possibilities and a greater degree of personal freedom."

Brazil: Move to Fiber Optics, Much Delayed, Begins

94WS0093A Sao Paulo VEJA in Portuguese 13 Oct 93 pp 58-60

[Article by Ricardo Galuppo: "Through a Glass Wire"; introductory paragraph in italics as published]

[Text] *After a delay of 15 years, Brazil is seriously entering the era of fiber-optic communications.*

A radical change in the panorama of Brazilian telecommunications has begun almost without being noticed. Since last month, two optical-fiber cables installed along the 450-km Dutra Highway have been carrying telephone calls between Sao Paulo and Rio de Janeiro. Each cable is as thick as the neck of a beer bottle. In it are the optical fibers—thin glass wires with the diameter of a strand of hair. The new system was designed to carry 124,000 telephone conversations simultaneously, thus quadrupling the capacity for connections between the two cities. Fifteen years behind the developed countries, Brazil has entered the era of long-distance data, sound, and image transmission using the optical system, which is 100 times faster than copper cables and has a useful life twice that of a satellite. "If Brazil had waited a little longer to invest in fiber optics, it would have found it difficult to talk to the rest of the world by the turn of the century," says Eng. Walter de Andrade Carvalho, a respected consultant in Sao Paulo.

Fiber optics is a system for transmitting information by means of light signals that began to spread around the world in the late 1970's. Three undersea cable systems are going to link Japan with the West Coast of the United States, and three more will connect the East Coast of the United States with Europe. U.S. President Bill Clinton recently announced the adoption of a plan—called the fiber optics superhighway—to link the chief cities of the United States. Brazil is leagues behind, but the reason for the nation's backwardness in this area is easy to understand.

For many years, optical fibers were included in the package of over 100 items whose importation was banned by Brazilian law, and domestic manufacturers were protected by the market reserve established for information technology. For years, Brazilian government-owned telecommunications companies could buy only fibers produced at the ABC Xtal factory in Campinas. Not even Italian-owned Pirelli, which had started producing fibers in Brazil before the market reserve was established, was allowed to bid for government contracts. "We manufactured the fibers here and had to sell them in countries such as Uruguay and Bolivia. Fortunately, that time has passed," says Eng. Ludgero Patarro, director of Pirelli's telecommunications division. Working in partnership with Japan's NEC, which developed the project, Pirelli produced the cables linking Rio de Janeiro and Sao Paulo.

Optical-fiber triangle: Until last month's inauguration, most of the optical-fiber lines existing in Brazil were urban. They linked stations owned by Embratel, Brazil's government-owned telecommunications company, and located within the same city. There was also a medium-distance line between Sao Paulo and Campinas that had been installed by Telesp, the Sao Paulo telephone company, a few years before. That picture is changing quickly. Next year an optical-fiber triangle linking Sao Paulo, Rio de Janeiro, and Belo Horizonte will be in operation. To complete the two missing sides of the triangle—the links between Belo Horizonte and the two other cities—over 1,000 km of cable will be installed. That stage of the project will cost about $100 million.

Last week Embratel began examining competitive bids for the installation of two other lines. The first will link the town of Sao Mateus in Espirito Santo with Porto Seguro in Bahia. The other will link Natal and Fortaleza. Those two sections constitute the land component of a much more ambitious plan. They will be interconnected by a system of undersea cables. Scheduled for completion by the end of 1995 is the Brazilian portion of a project that will link South America with the rest of the world through fiber optics. The entire domestic network is expected to cost $1.4 billion.

The only advantage Brazil gains by getting a late start with fiber optics is that it will pay less for its lines. Technology has evolved in recent years, and the fibers are better and less expensive today than they were a decade ago. Ten years ago, it cost exactly $1 to produce one meter of optical fiber. Now the developed countries can produce one meter of fiber for $0.07. It costs Brazilian manufacturers such as ABC Xtal, Pirelli, and Abracel slightly more than that: from $0.10 to $0.11 per meter. At present, any foreign company can participate in competitive bidding in Brazil. The cost of installing a optical-fiber line is relatively low compared to that of a conventional telephone line.

Ipanema and Copacabana: A few years ago, the National Highway Department (DNER) installed a system of conduits along the Dutra Highway. Those conduits carried the copper cables for the DNER's internal communications system between Sao Paulo and Rio de Janeiro. To install the optical-fiber line, the only thing necessary was to draw the new cables through those conduits and set up eight automatic relay stations along the way. The relay stations amplify the signals and make it possible for someone in Ipanema to hear the voice of a friend in Sao Paulo more clearly than he would hear a call from Copacabana, an adjoining neighborhood. In future links, the government-owned firm will lay cables one meter deep alongside federal highways and railroads. It will not be necessary to spend money to expropriate land or to build complex civil engineering structures.

"Optical fibers do not replace all communication methods, but they are unbeatable in the things that they can do better," says Eng. Gilberto Viana, head of Embratel's Land Communications Department. Satellites are still irreplaceable when it comes to communicating with remote areas such as the Amazon Region. The cost of installing and maintaining an optical-fiber cable through the jungle would be very high in relation to the benefits provided by such a system. Most long-distance telephone connections and all international connections in Brazil are handled by the satellite communication system. When the entire system is in place, 75 percent of the traffic will be carried by the fiber optics system.

Business opportunities: The Brazilian subsidiary of the U.S. telecommunications company AT&T estimates that on the day when the system is completely installed, Brazil will be able to double the number of telephone lines with a quality

of service superior to that existing now. The country currently has about 12 million lines, and only seven out of every 12 Brazilians have a telephone. That is one of the lowest averages in South America. Besides helping to improve that score, fiber optics will help open up the possibilities for new technologies such as interactive television and multimedia services, which are already being introduced in American homes by means of fibers. "Thanks to fiber optics, telephone lines are no longer limited exclusively to telephone calls; instead, they are starting to be used to transmit a number of different signals," says Adley Alves Pereira of Brazilian AT&T. "They are becoming a two-way channel through which the user can interact with the person sending him the signals."

The same optical-fiber line can carry telephone calls, TV pictures, and alarm systems simultaneously. The system also carries messages exchanged between computers located kilometers apart. The installation of those services alone should generate business opportunities estimated to be worth over $1.5 billion annually in the field of connections and new systems. In the United States, all those services are within reach of most of the population. Out of every group of 100 Americans, 60 receive cable TV signals in their homes by way of optical fibers. In Brazil, most of the existing cable TV services use their own networks linked by copper cables.

Linking the big cities is the first step in bringing the convenience already enjoyed by Americans closer to Brazilians. After that, it will be necessary to adapt the urban networks to the new system. The amount of money required is tremendous, and it is unlikely that the government-owned system will be able to finance the whole undertaking alone. A number of alternative solutions are being considered, but implementing them will require changes in the Constitution. "The speed at which the country is incorporated into this system will have to be much faster than it is now. Embratel and the telecommunications companies owned by the states cannot afford to improve service at the pace required by Brazil," says Eng. Raul Del Fiol, a telecommunications expert at Promon Engineering. Embratel wanted to invest a total of $4.6 billion this year, but the government ordered a 25-percent cut in the company's budget. "If the law did not prohibit it, private enterprise would have covered the difference and also invested a lot more money in the country," says Del Fiol.

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